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VOL. CXXXIX.—No. 3625] LONDON: FRIDAY EVENING, JUNE 19, 1925 [PRICE { WITH SUPPLEMENT } ONE SHILLING BY INLAND POST 1s. 3d.

The Engineer

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PUBLIC NOTICES

Ministry of Transport.

PURFLEET-TILBURY ROAD, ESSEX.
SIDCUP BY-PASS ROAD, KENT.

The Minister is prepared to receive TENDERS for the following SURFACING WORKS:—

PURFLEET-TILBURY ROAD.—BITUMINOUS CLINKER or ASPHALTIC CONCRETE MATERIAL.

SIDCUP BY-PASS ROAD.—BITUMINOUS CLINKER or ASPHALTIC CONCRETE MATERIAL and TARRED MACADAM.

Forms of Tender, conditions of Tender, conditions of contract, bills of quantities, general specifications and drawings will be available for issue on the 29th June, 1925, and may be obtained from the Chief Engineer, Roads Department, Ministry of Transport, 7, Whitehall-gardens, S.W.1, upon payment of a deposit of £25 in respect of each road. This amount will be returned to the tenderer in respect of each Tender if his Tender is a bona fide one and has not been withdrawn prior to the definite acceptance of a Tender or Tenders by the Minister.

Tenders, on the official form, accompanied by fully priced bills of quantities, must be enclosed in separate sealed envelopes, marked "Purfleet-Tilbury Road Tender" and "Sidcup By-pass Road Tender" respectively, and submitted to the undersigned on or before 10 a.m. on the 6th day of July, 1925.

The Minister does not bind himself to accept the lowest or any Tender and reserves to himself the right to accept the Tenders of different contractors for the different sections of the Purfleet-Tilbury Road.

Dated this fifteenth day of June, 1925.

H. H. PIGGOTT,
Assistant Secretary.

Ministry of Transport. 9523

TO CONTRACTORS.

The Commissioners of His Majesty's Works, &c., are prepared to receive separate TENDERS before 11 a.m. on Friday, 3rd July, 1925, for the SUPPLY of (a) MECHANICAL and (b) ELECTRICAL ENGINEERING LABOUR in the Manchester district during a period of 3 years from the 1st August, 1925.

Forms for Tender, &c., may be obtained from the CONTRACTS BRANCH, H.M. Office of Works, King Charles-street, London, S.W.1. 9494

The Director-General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E.1, invites TENDERS for —

1. STEEL SCREW SPIKES.
2. PETROL TANK RAILWAY WAGONS.
3. TWO DRAGLINE EXCAVATORS, 85ft. boom, buckets 2¼ yards capacity.
4. WHEELS and AXLES for RAILWAY CARRIAGES.
5. UNDERFRAMES, BOGIE TRUCKS, IRONWORK, &c., for RAILWAY CARRIAGES.

Tenders due on the 25th June, 1925, for No. 1, on the 7th July, 1925, for No 2, on the 9th July, 1925, for No. 3, and on the 14th July, 1925, for Nos. 4 and 5.

Tender forms obtainable from above. 9526

The Government of India

REQUIRE in October next the following STAFF for the Construction of the Visagapatam Harbour:—

(A) A DEPUTY CIVIL ENGINEER-IN-CHIEF. Qualifications: Age not less than 35 years; Chartered Civil Engineer or equivalent qualification; experience of dock and harbour works; knowledge of monolith construction. Salary Rs. 1000-100-2000 per mensem.

(B) An EXECUTIVE ENGINEER. Qualifications: Experience in marine survey, suction dredging and reclamation work. Salary Rs. 1000-100-1400 per mensem.

(C) An ASSISTANT CIVIL ENGINEER. Qualifications: Chartered Civil Engineer, or possession equivalent qualification; training on dock and harbour works; experience in charge of drawing-office. Salary at rate to be fixed between Rs. 600 and Rs. 1000 per mensem, according to qualifications.

The terms of the above appointments will include an agreement for five years, free first-class passage to India and return passage on satisfactory termination of services, and Provident Fund benefits.

Further particulars and forms of application may be obtained from the SECRETARY to the HIGH COMMISSIONER FOR INDIA, 42, Grosvenor-gardens, London, S.W.1. Last date for receipt of applications 13th July, 1925. 9502

Draughtsmen Required

at the ROYAL AIRCRAFT ESTABLISHMENT.

Ref. A.70.—ONE DRAUGHTSMAN, Grade I., for instrument design. Good technical knowledge and considerable experience in the design of instruments or small precision apparatus are essential. Starting salary £160 p.a. plus Civil Service bonus, giving present total of £258 8s. on the scale of £160-10-£200 p.a., plus C.S.B.

Ref. A.71.—ONE DRAUGHTSMAN, Grade III., for aircraft and engine work. Good technical knowledge and works and drawing-office experience necessary. Starting salary 45s. to 52s. p.w. plus Civil Service bonus, giving present totals of 76s. 9d. to 86s. 4d. p.w. Ex-Service men preferred.

Write, stating full particulars and quoting appropriate reference number, to the SUPERINTENDENT, R.A.E., S. Farnborough, Hants. 9524

City and County of Norwich.

THORPE POWER STATION.

The Norwich Corporation invite TENDERS for the MANUFACTURE, DELIVERY and ERECTION of the undermentioned ENGINEERING WORKS in connection with the above Power Station, viz:—

STEAM, WATER and other PIPE WORK, VALVES, TANKS, &c. &c.

Specifications, drawings and forms of Tender may be obtained from Messrs. Preece, Cardew and Rider, 8, Queen Anne's-gate, Westminster, S.W.1, on payment of a deposit of £5, which will be refunded on receipt of a bona fide Tender within the prescribed time.

Two copies of the specification and form of Tender will be supplied to each applicant. Extra copies may be obtained on payment of Ten Shillings for each copy, which will not be returnable.

Sealed Tenders, endorsed "Thorpe Power Station, Tender for Pipe Work, &c.," must be delivered to me at my office not later than 10 a.m. on Friday, 3rd July, 1925.

The lowest or any Tender will not necessarily be accepted, and the Corporation will not consider any Tender which is incomplete, or which does not include the whole of the work covered by the specification.

ARNOLD H. MILLER,
Town Clerk.

Guildhall, Norwich,
8th June, 1925. 9419

PUBLIC NOTICES

Bradford Education Committee.

TECHNICAL COLLEGE.

APPLICATIONS are INVITED for APPOINTMENT as HEAD of the DEPARTMENT of MECHANICAL ENGINEERING in the College.

A salary up to £700 per annum may be paid to a candidate of suitable qualifications and experience.

Full particulars of the appointment and forms of application may be obtained from the Principal of the College, to whom applications should be returned completed not later than Friday, 3rd July, 1925.

N. L. FLEMING,
Town Clerk.

9479

Municipal Technical School, SWANSEA.

PRINCIPAL: T. GILBERT JONES, M.Sc., Wh.Sch., A.M.I.E.E., A.M.I.C.E.

LECTURESHIP IN ELECTRICAL ENGINEERING.

APPLICATIONS are INVITED for the POSITION of LECTURER in ELECTRICAL ENGINEERING. Applicants must possess a University Degree or its equivalent and have had works experience. Teaching experience desirable. Salary according to Burnham Technical Scale. Forms of application and conditions of appointment may be obtained from the undersigned, by whom applications, accompanied by copies of recent testimonials, must be received not later than first post on Wednesday, the 24th June.

T. J. REES,
Director of Education.

Education Office,
Dynevor-place, Swansea,
9th June, 1925. 9440

Bombay, Baroda, and Central India Railway Company.

The Directors are prepared to receive up to 2.30 p.m. on Wednesday, 1st July, TENDERS for the SUPPLY of:—

COPPER FIRE-BOX PLATES.

Tenders must be made on forms, copies of which, with specification, can be obtained at these offices on payment of 10s. each (which will not be returned).

The Directors do not bind themselves to accept the lowest or any Tender.

S. G. S. YOUNG,
Secretary.

Offices: 91, Petty France,
Westminster, S.W.1,
17th June, 1925. 9522

The South Indian Railway Company, LIMITED.

The Directors are prepared to receive TENDERS for the SUPPLY of:—

LOCOMOTIVE BOILERS.

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W.1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tender for Locomotive Boilers," must be left with the undersigned not later than Twelve Noon on Friday, the 10th July, 1925.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of £1 for each copy of the specification.

Copies of the drawings may be obtained at the offices of the Company's Consulting Engineers, Messrs. Robert White and Partners, 3, Victoria-street, Westminster, S.W.1.

A. MUIRHEAD,
Managing Director.

91, Petty France, S.W.1,
17th June, 1925 9529

PUBLIC NOTICES

County Council of the County of PERTH

(HIGHLAND DISTRICT COMMITTEE).

INVERNESS-PERTH ROAD.

CONSTRUCTION, RECONSTRUCTION, AND SURFACING.

CONTRACT NO. 2.

From the County Boundary with Inverness-shire to Dalnamein Lodge, a length of approximately 9¼ miles.

EARTHWORKS, BRIDGES, BOTTOMING, SURFACING, DRAINAGE, AND FENCING.

The Council are prepared to receive TENDERS for the CONSTRUCTION of the above SECTION of the INVERNESS-PERTH ROAD, being the third portion of a total length of 80 miles.

Drawings and specifications, &c., may be seen on and after 19th June, 1925, at the offices of

The Chief Engineer, 98-102, Academy-street, Inverness;

The District Surveyor, Aberfeldy;

The Ministry of Transport, 122, George-street, Edinburgh;

The Ministry of Transport (Roads), 7, Whitehall-gardens, London, S.W.1.

Specification, bill of quantities, form of Tender, and all information required may be obtained on and after the same date at the office of the Chief Engineer, Major Robert Bruce, 98-102, Academy-street, Inverness, on depositing £3 3s., which deposit will only be returned on the receipt of a bona fide Tender and the return of all the documents. Cheques should be made payable to the County Council of the County of Perth.

A conveyance will be provided and an Engineer will meet contractors at Struan Railway Station at 1.20 p.m. on Tuesday, the 23rd June, 1925, to show them over the route.

Sealed Tenders, endorsed "Tender, Inverness-Perth Road, Contract No. 2," must be lodged with the undersigned not later than Saturday, the 4th July, 1925.

The Council do not bind themselves to accept the lowest or any Tender.

MITCHELL and LIDDELL,
Joint District Clerks.

Pitlochry,
13th June, 1925. 9484

Port of Bristol.

RECONSTRUCTION OF SHEDS "E" AND "F," BRISTOL.

The Docks Committee invite TENDERS for the RECONSTRUCTION of the TRANSIT SHEDS known as Sheds "E" and "F," situate on the Grove, Bristol.

The new shed will have a double floor with a ground area of 3300 square yards. The superstructure will contain 400 tons of steel and ironwork. The first floor will be boarded on timber joists and the roof will be slated on boarding and timber purlins. The foundations will be in concrete.

On and after Monday, the 22nd June, 1925, a copy of the form of Tender, general conditions, specification, schedule of prices, and a copy of the contract drawings can be obtained from the undersigned on production of a receipt showing that a deposit of £5 has been paid to the General Manager and Secretary of the Bristol Docks Committee, 19, Queen-square, Bristol. ALL CHEQUES MUST BE MADE PAYABLE TO THE BRISTOL DOCKS COMMITTEE. The deposit of £5 will be returned hereafter to all bona fide tenderers.

Tenders must be enclosed in a sealed envelope, endorsed "Tender for the Reconstruction of Sheds 'E' and 'F,' Bristol," addressed to the General Manager and Secretary of the Docks Committee, 19, Queen-square, Bristol, and must be delivered to him, accompanied by the prescribed documents and drawings, before 10 a.m. on Monday, the 20th July, 1925.

The Docks Committee do not bind themselves to accept the lowest or any Tender.

THOMAS A. PEACE,
Chief Engineer,
Port of Bristol.

Chief Engineer's Office,
Avonmouth Docks,
19th June, 1925. 9508

PUBLIC NOTICES

City and County of Kingston-upon-Hull.

WATERWORKS.

COTTINGHAM PUMPING STATION.

CONTRACT NO. C.1.

The Water and Gas Committee of the Corporation of Kingston-upon-Hull invite TENDERS for the CONSTRUCTION of the UNDERGROUND WORKS required in the enlargement of the existing Pumping Station at Cottingham, in the East Riding of Yorkshire.

The works to be executed include the Removal of existing Pumping Machinery, the Deepening of Three Wells, the Deepening of Ten Shafts, in chalk, and the Construction of Five New Shafts in chalk covered with drift, the Driving of 4200ft. of Adits at a depth of 120ft. below ground level, and the Sinking of Twelve Bores. The quantity of water to be raised from the workings during construction will probably exceed 15 million gallons a day.

The drawings may be inspected and specifications, schedule of quantities, and form of Tender obtained on application to the undersigned. A deposit of Five Pounds in Bank of England or Treasury notes is required and will be returned on receipt of a bona fide Tender.

Tenders, endorsed "Cottingham Works," are to be addressed to the Chairman of the Water and Gas Committee and delivered at the Town Clerk's office not later than Tuesday, 14th July, 1925.

By Order,
CHARLES B. NEWTON,
Engineer.

Guildhall, Hull,
15th June, 1925. 9497

County Borough of Brighton.

WATERWORKS DEPARTMENT.

TO MAIN-LAYING CONTRACTORS.

The Waterworks Committee are prepared to receive TENDERS from responsible contractors for LAYING about 2530 YARDS of 18in. and about 1780 YARDS of 16in. CAST IRON MAINS in Ditchling-road, Hollingbury-road, Hollingdean-road, Old-lane, and Surrenden-road, Brighton.

Specification, quantities, and form of Tender may be obtained and drawings inspected on application to Mr. A. B. Cathcart, M. Inst. C.E., Waterworks Engineer, 12, Bond-street, Brighton, on payment of a deposit of Three Guineas, which will be refunded upon receipt of a bona fide Tender not subsequently withdrawn and the return of all documents.

Sealed Tenders, endorsed "Tender for Laying 18in. and 16in. Water Mains," to be delivered at my office, Town Hall, Brighton, not later than Noon on Monday, July 6th, 1925.

The lowest or any Tender will not necessarily be accepted, and Tenders will only be considered from responsible contractors having the necessary experience.

JAS. H. ROTHWELL,
Town Clerk.

Town Hall, Brighton,
10th June, 1925. 9450

County Borough of Brighton.

WATERWORKS DEPARTMENT.

TO PIPE FOUNDERS.

The Waterworks Committee invite TENDERS for the SUPPLY of about 960 TONS of 16in. diameter, Class "C," 240 TONS of 16in. diameter, Class "B," and about 320 TONS of 18in. diameter, Class "C" CAST IRON PIPES to the British Standard Specification, together with SPECIALS of both diameters, delivered in Brighton.

Specification and form of Tender may be obtained from the Waterworks Engineer, Mr. A. B. Cathcart, M. Inst. C.E., 12, Bond-street, Brighton, upon payment of a deposit of Two Guineas, which will be refunded upon receipt of a bona fide Tender not subsequently withdrawn.

Sealed Tenders, endorsed "Tender for C.I. Pipes," to be delivered at my office, Town Hall, Brighton, not later than Noon on Monday, July 6th, 1925.

The Committee do not bind themselves to accept the lowest or any Tender.

JAS. H. ROTHWELL,
Town Clerk.

Town Hall, Brighton,
10th June, 1925. 9451

Sudan Government Railways

REQUIRE the SERVICES of a DISTRICT LOCOMOTIVE SUPERINTENDENT. Age 26 to 32. Preferably single. Candidates should have been trained on a British railway or in a locomotive builders' works, and should have good knowledge of the working of a locomotive department. Commencing salary £E480 to £E540, according to age and qualifications. Permanent and progressive post if satisfactory. A.M.I.C.E. degree or equivalent desirable. Strict medical examination. Free first-class passage. Liberal leave and assisted passages.—Apply by letter to ADVISORY ENGINEER, Sudan Government, London Office, Wellington House, Buckingham-gate, S.W.1. 9491

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PUBLIC NOTICES

City of Oxford.

CHIEF ENGINEMAN.

The Corporation of Oxford invite APPLICATIONS from skilled Mechanics for the APPOINTMENT of CHIEF ENGINEMAN at their Waterworks Pumping Station, Hinksey, Oxford.

Preference will be given to those having experience in the construction and management of "Worthington" and Rotary Pumping Engines.

Wages £4 per week, with house, coal, and gas free. Further particulars can be obtained from the City Engineer, Town Hall, Oxford.

Applications, in candidates' own handwriting, enclosing not more than three recent testimonials, stating present employment, past experience, age, and whether married or single, must be delivered to me not later than Saturday, July 4th, marked on the envelope "Chief Engineman."

The successful candidate will be required to contribute under the Local Government and other Officers' Superannuation Act, 1922, and to pass a medical examination.

Canvassing members of the Council will disqualify.

A. HOLT,
Town Clerk.

Town Clerk's Office, Oxford.
12th June, 1925. 9483

Epsom Urban District Council.

APPOINTMENT OF ELECTRICAL ENGINEER.

The Council invites APPLICATIONS for the above APPOINTMENT from fully qualified Electrical Engineers, who must have had experience as Chief or Chief Assistant Engineers, in Electricity Generating Stations, with Diesel, Semi-Diesel and Steam Engines, and Three-wire System of Distribution.

The salary will be £450 per annum, which will carry no bonus, but will be subject to percentage deductions in accordance with the Local Government and other Officers' Superannuation Act, 1922, which has been adopted by the Council, and the appointment will be subject to the selected candidate satisfactorily passing a medical examination, unless he is at present the occupant of an established post under the Act.

The person appointed will be required to devote his whole time to the office, and the appointment will be determinable by three months' notice by either party at any time.

Applications, stating age (which must not be less than 30 and not exceeding 45), qualifications, experience and the earliest date upon which the applicant can commence duties, accompanied by copies only of not more than three recent testimonials, must be sent to me in envelopes, endorsed "Electrical Engineer," so that they shall be received at 37, Church-street, Epsom, by Saturday, 27th June, 1925.

Canvassing, either directly or indirectly, will be considered a disqualification.

E. G. WILSON,
9481 Clerk of the Council.

South Staffordshire Water-Works Company.

CIVIL ENGINEERING DEPARTMENT.

APPLICATIONS are INVITED from qualified persons for the APPOINTMENT of RESIDENT ENGINEER on the Construction of a Reinforced Concrete Reservoir of about seven million gallons capacity and contingent works at Dudley.

Applicants must be corporate members of the Institution of Civil Engineers, have had considerable experience in reinforced concrete construction, preferably in relation to waterworks, and be capable of carrying out the tests for cement as laid down in the latest British Standard Specification for Portland Cement.

A medical certificate of fitness will be required.

The salary will be at the rate of £450 per annum inclusive, and the duration of the appointment eighteen months to two years.

Applications, stating age and giving details of education, training and experience, accompanied by copies only of three recent testimonials, should be addressed and delivered to the undersigned not later than 6th July, 1925.

FRED. J. DIXON, M. Inst. C.E.,
Engineer-in-Chief.

Engineer's Office,
26a, Paradise-street, Birmingham,
14/6/1925. 9501

SITUATIONS OPEN

WANTED, a YOUNG MAN, 30 to 35 Years of Age, to Assist in General Management of Large High-class Machine Tool Works. Must have had shop, drawing-office and commercial experience in the trade. Knowledge of French desirable. Good opportunity for suitable man. Give full particulars of experience, copies of testimonials, age, and salary.—Address, 9418, The Engineer Office. 9418 A

WANTED, ASSISTANT ENGINEER, Experienced in Boiler Plant Design, with particular reference to specifications, correspondence, negotiations, &c. In replying give details as to education and experience, with list of firms served and period of service with each, also state salary expected.—Address, 9518, The Engineer Office. 9518 A

WANTED by Leading Engineering Insurance Company, additional INSPECTORS, fully qualified in best Crane and Lift Practice. Commencing salary £260 per annum.—Address, with full particulars of experience, age, &c., 9521, The Engineer Office. 9521 A

WANTED.—TUBE TRADE.—A British Firm, making a speciality of high-class Steam and Water Pipe Installations, REQUIRES the SERVICES of a thoroughly experienced and competent SALES ORGANISER. Salary £1000 per annum and good commission. All applications will be treated in strictest confidence, but it is useless applying unless with actual experience of the tube trade at home and abroad.—Address, 9488, The Engineer Office. 9488 A

CONSTRUCTIONAL ENGINEERS in London REQUIRE SERVICES of an ASSISTANT to WORKS FOREMAN.—Address, stating age, experience and salary required, P728, The Engineer Office. P728 A

ENGINEER WANTED by Large Firm of Contractors, capable of Supervising the Design and Erection of Steam Power Stations and Accessories. Applicants must have the following qualifications:—Had a Technical College Training; served an Engineering Apprenticeship; been employed in a Power Station; had actual experience in Designing and Erecting Steam Plant.

No application not possessing the above qualifications will be considered. Salary to be stated.

Address, P735, The Engineer Office. P735 A

ENGINEER WANTED, with Full Experience of Elevating and Conveying Machinery, particularly Apparatus dealing with Boxes, Packages, &c.—Address, giving age, details of past experience and salary required, 9509, The Engineer Office. 9509 A

THE MADRAS ELECTRIC SUPPLY CORPORATION, Ltd., REQUIRES an ASSISTANT POWER STATION SUPERINTENDENT, age 25 to 30, unmarried; three years' engagement; salary Rs. 500 to Rs. 650 per mensem. Boiler-house experience indispensable.—Applications, stating full particulars of past and present appointments, to be made in writing only to the SECRETARY, 1, Queen Victoria-street, London, E.C. 4. 9503 A

WELL-KNOWN FIRM of Internal Combustion Engine Manufacturers (Stationary and Marine), REQUIRE ENGINEER, with good commercial and technical training, to Control SALES DEPARTMENT and branches thereof. Must have GOOD CONNECTION and knowledge of the trade. Applications, giving full details of experience, salary required, &c., will be treated with STRICT CONFIDENCE.—Address, 9492, The Engineer Office. 9492 A

WANTED, DRAUGHTSMAN, by Well-known Firm of Milling Engineers.—Address, stating experience, &c., 9285, The Engineer Office. 9285 A

AN URGENT NATIONAL PROBLEM.

—Our Wasted Coal Resources is dealt with in all its aspects in

LOW TEMPERATURE DISTILLATION.

By Sydney H. North and J. B. Garbe.

The question of utilizing the whole of the contents of our mines is one of the most vital to-day. A Home oil supply can be secured by treating coal by modern low temperature distillation. This and other important questions are dealt with in detail in this new, practical book.

Contents: Early Experiments. Carbonization and Distillation of Coal. By-Product Coke Oven. Fuel Research Board Experiment. Modern Practice and Plant for L.T. Carbonization. Special Points. Materials Available in Great Britain. Liquid Fuels from Coal. Treating the Residue from Distillation. Coal Agglomerate. Belgian Briquetting Plant. Oil Shales. Lignite. Peat. Etc.

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Full particulars post free from—

SIR ISAAC PITMAN & SONS, LTD.,
PARKER STREET, KINGSWAY, W.C.2.

SITUATIONS OPEN (continued)

UNDER MANAGER WANTED for Factory in the North-West of England. Must be first-class Maintenance Engineer, sound organiser possessing initiative and tact. Permanent and progressive post for the right man. Applications should state age, whether married or single, experience and salary required.—Address, 9477, The Engineer Office. 9477 A

WANTED AT ONCE by Constructional Engineers in London, first-class DESIGNER, used to Steel-framed Buildings to L.C.C. requirements and General Structural Work. Only first-class men should apply, giving age, experience, and salary required.—Address, 9517, The Engineer Office. 9517 A

WANTED, Experienced DESIGNER, Young and energetic, knowledge of Hydraulic Machinery and General Engineering essential.—Apply, HENRY BERRY and CO., Ltd., Croydon Works, Leeds. 9485 A

WANTED, Experienced DRAUGHTSMAN (not less than 5 years' experience) in designing Heating, Hot Water Supply, Ventilation, and large Centralised Plants.—Address fully, giving age and salary required, 9402, The Engineer Office. 9402 A

WANTED in Manchester District, LEADING CRANE DRAUGHTSMAN; preference given to one with experience in Overhead Runways and Pulley Blocks.—Address, stating experience, age, wages required, 9482, The Engineer Office. 9482 A

WANTED, MECHANICAL DRAUGHTSMAN, with experience of small Jig and Chuck Design. State age, experience and salary expected.—KINGSTON ENGINEERING CO., West-road, Portslade. P734 A

CHIEF DRAUGHTSMAN of Proved Organising capacity REQUIRED for Drawing-office Staff of about 20 men by firm of Steam Engineers and Steam Wagon Makers in Midlands.—Address, 9405, The Engineer Office. 9405 A

CONSTRUCTIONAL DRAUGHTSMAN, Well-experienced in Design of London Steel-framed Buildings. State experience and salary required.—Address, P738, The Engineer Office. P738 A

DRAUGHTSMEN.—BEFORE NEGOTIATING with Government Departments in connection with any post, PLEASE COMMUNICATE with the GENERAL SECRETARY, Association of Engineering and Shipbuilding Draughtsmen, 96, St. George's-square, London, S.W. 1. 8768 A

DRAUGHTSMAN.—Old-established Firm of General Engineers REQUIRE the SERVICES of a good reliable MAN, experienced in the Preparation of Accurate Working Drawings. State age, salary and experience.—Address 9493, The Engineer Office. 9493 A

DRAUGHTSMAN REQUIRED, Experienced in Rotary Printing Press Work.—Address full particulars of experience and salary required, 9395, The Engineer Office. 9395 A

DRAUGHTSMAN REQUIRED, with Wide Experience of High-speed Engines and Condensing Machinery, as well as Lay-out of Central Station Plants. Only first-class men need apply.—Write, giving full particulars, with age and salary required, to W. H. ALLEN, SONS and CO., Ltd., Bedford. 9499 A

DRAUGHTSMAN WANTED for About Six Months, on Jig and Tool Work.—Address, with particulars re salary, &c., P745, The Engineer Office. P745 A

DRAUGHTSMAN, with Knowledge of Heating, Ventilating, and Cooking Installations.—Address, giving particulars of experience and salary required, P741, The Engineer Office. P741 A

OLD-ESTABLISHED COMPANY in Calcutta REQUIRES ASSISTANT DRAUGHTSMAN; age 22-25, with Workshop Experience, for preparation of Shop Drawings for Structural Steelwork.—Give full particulars, experience, state age and salary required, to "Z F 692," care of Deacon's Advertising Offices, 11, Fenchurch-avenue, London, E.C. 3. 9478 A

REQUIRED, a First-class BRIDGE and STRUCTURAL ENGINEERING DRAUGHTSMAN for a Municipal Engineer's Office in the North of England. State full particulars, experience and salary required.—Address, 9504, The Engineer Office. 9504 A

REQUIRED for Important Argentine Railway, ARCHITECTURAL DRAUGHTSMAN, with thorough knowledge of Building Construction. Must be neat draughtsman, capable of preparing working drawings. Will be required to design Goods Warehouses, Passenger Stations, Engine Sheds, &c. Should preferably know something about armoured concrete; aged 26/32; three years' contract at £400, £450, and £500 p.a., with free passage out and home.—Write, stating age, training and experience, whether single or married, &c., with copies only of testimonials, to Box C.T., c/o Davies and Co., 95, Bishopsgate, E.C. 2. 9506 A

SITUATIONS OPEN (continued)

REQUIRED for an Important Argentine Railway, STEEL WORK DRAUGHTSMAN, aged 26/32. Must have had thorough grounding in design of Bridge Work and Steel Frames for Buildings. Able to draw out work in detail for tracing and prepare comprehensive calculations. Three years' contract at £400, £450, and £500 p.a., with free passage out and home.—Write, stating age, training and experience, whether single or married, &c., with copies only of testimonials, to Box R.B.A., c/o Davies and Co., 95, Bishopsgate, E.C. 2. 9505 A

STRUCTURAL DRAUGHTSMEN REQUIRED for important Constructional Engineers in Manchester District. Must be first-class men, well up in the design and detailing of Steel-framed Buildings. Good salaries paid to the right men; no others need apply.—Address, stating age, experience, and salary required, 9519, The Engineer Office. 9519 A

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For continuation of Small Advertisements see page 3.

A Seven-Day Journal

Faraday.

A MEETING, arranged by the Royal Society, the Chemical Society, the Society of Chemical Industry, and the Association of British Chemical Manufacturers, was held at the Royal Institution on Tuesday, June 16th, to celebrate the centenary of the discovery of benzene by Faraday. Delegates from many countries were received by the Duke of Northumberland, who, in the course of a speech, said that what Faraday achieved in his time could be achieved by the rising generation of scientists to-day. He held that the most distressing feature of the times was our failure to link up scientific methods and discoveries with the public service. It might be, he thought, that the present serious state of many of our great industries would teach our rulers that salutary lesson and induce them to seek in science the solution of those problems which had proved so baffling to the present generation. Dr. H. E. Armstrong spoke in the same spirit. "We were," he said, "too little mindful of the public interest; we were doing too little to make scientific method a public possession; Faraday's dream was in no way fulfilled; the spirit of science in no way entered into our commerce, our industry, our public life." Lord Balfour, who also addressed the meeting, followed in the same vein. "Neither statesmen nor men of business," he asserted, "had taken all they could from the actual knowledge which science had already acquired. Let them mend their ways, and remember that new discoveries could not be expected to produce an immediate result to be measured either in human convenience or in commercial dividends." A banquet was held in the hall of the Goldsmiths' Company in the evening.

The Queen Mary Reservoir.

THE huge reservoir in the Thames Valley, which, during the long period covered by its construction, was known by the name of "Littleton," was formally put into service on Saturday last by his Majesty the King, who renamed it the Queen Mary Reservoir. To the war is due the fact that this very valuable addition to the storage capacity controlled by the Metropolitan Water Board was not available several years ago. The work of construction was begun in 1914, but after being carried on for some eighteen months under increasing difficulties brought about by military requirements, it was stopped for a period of over three years. We begin to give a detailed description of it and its accessory works in another column of this issue, so that it is not necessary to refer to it at great length here. It may be said, however, that it is a logical development of the policy of creating as much water storage reservoir capacity as possible in the valleys of the Thames and Lea, rather than going as far afield as Wales to obtain additional supplies, which was initiated by the old London water companies and has been followed consistently by the Water Board. We believe, in fact, that we are right in saying that the work now brought to a conclusion was envisaged in principle, at any rate, by the man primarily responsible for the design of the Staines Reservoirs—the late Mr. Walter Hunter, M. Inst. C.E.

Air Route to India.

SOME further particulars of the Government's intentions with regard to the airship service to India were given on Monday last by Sir Samuel Hoare, Secretary for Air. The first step of the scheme is to be the establishment of a service between Egypt and India, and for this purpose it is proposed to transform the military route into an air route. The Indian terminus is to be Karachi. Then, in two years' time, when the two great airships, now under construction, are completed, it should be possible to make the journey from England to Bombay entirely by air in four days, and to convey 100 passengers, besides mails, at each trip. In connection with light aeroplanes, it was proposed, Sir Samuel stated, to arrange four or five auxiliary squadrons on the lines of the Territorial Army, and to foster the organisation of light aeroplane clubs and training squadrons at the Universities.

House Cooling.

A NOVEL form of reducing the high indoor temperatures, to which we have been subjected for the past fortnight, has just been tried in London, and has, we understand, proved very satisfactory. In the structure of Bush House, Aldwych, there was incorporated an elaborate system of piping for heating purposes in cold weather, and it is now doing duty for cooling the rooms by the simple expedient of pumping cold water through the pipes. The success of the idea is however, due to the peculiar arrangement of the piping. Instead of using ordinary radiators, for heating the building, grids of ¼in. pipes are arranged in the walls just beneath the surface, so as to make a large area of the wall effective for radiation and to reduce in proportion the temperature difference necessary between the water in the pipes and the atmosphere. As an experiment, the effect was first tried of circulating ordinary main's water through the grids, but it was not sufficiently cold to have any appreciable result. When, however, water from the artesian well belonging to the house was used, a considerable reduction in the temperature of the rooms was produced, as the well water is naturally cool at this time of the year. Finally, some ice was put in the water tank, and the room temperature was brought down from 84 deg. to 72 deg. It would, of course, have been impracticable to seek this result with ordinary radiators, as their limited surface area would have necessitated the water being very cold to get the required transfer of heat, and freezing of moisture on the outside of the system would have caused inconvenience.

Russian Manganese.

IT appears that an agreement has now been reached between the Soviet Government and the Harriman combine in America, concerning the Chiatura manganese mines in Russia. At one time these mines had an annual output of 2,000,000 tons, but production has been comparatively insignificant since the revolution. Now, however, the concessionnaires are required to export not less than 16,000,000 tons of manganese during the twenty years for which the contract holds good—the annual amount increasing progressively. It is also stipulated that within 3½ years new reduction plant and mechanical handling devices in the mines are to be installed, while at the end of five years there must be an elevator at Poti capable of handling 2,000,000 tons of ore a year. A heavy fine is to be imposed if the concessionnaires fail in their obligations. The Soviet Government has reserved to itself an area estimated to contain some 15,000,000 tons of ore, which may be worked by the Government for home consumption. The royalty is to be from 3 to 4 dollars per ton of manganese.

British Foundry Practice.

LAST week the Institute of British Foundrymen held its annual convention in Glasgow—it was the third time that the function had taken place in that city—under the chairmanship of Mr. John Cameron, of Kirkintilloch. In his presidential address Mr. Cameron pointed out the necessity for putting into practice the experience and knowledge which had been accumulated by the Institute, and suggested that the present time, when the foundries were comparatively slack, was very convenient for introducing new practices. The British foundryman was, he said, very conservative, and he hoped that the industry would be encouraged to abandon "rule of thumb" methods for more progressive ideas. At present too much of the moulder's time was taken up in the preparation and handling of the sand, in ramming and in lifting boxes. Mechanical means should be used more extensively for those purposes, and, in that connection, a cheap power supply was essential. There was, he said, a growing demand for high-class iron castings, and engineers required, in order to carry out their designs, castings of lesser weight without any reduction of strength. Such castings could only be produced by the combination of scientific knowledge with efficient foundry equipment and procedure. A number of papers were read at the meeting, and the members visited several industrial establishments in the district.

Failure of the Electric Supply at Rugby.

FOR nearly ten hours Rugby was recently completely without electric light and power. On account of a fault in a cable near Warwick the current supply was cut off, and as a result of the delay which has arisen in securing wayleaves for overhead lines to the town no alternative supply at present exists. Normally the current is received by cable from the Warwickshire and Leicestershire Power Company which has a generating station at Warwick. The breakdown in the cable occurred near the station, where the cable crosses the river Avon, and although repairs were begun as soon as possible it was found when the extent of the damage was investigated that the supply could not be restored for a considerable time. Arrangements were therefore made to obtain power from the British Thomson-Houston Company, which formerly supplied the town, but which now receives current from the same source as Rugby. It was therefore possible through the kindness of the company to utilise its generating plant. The necessary work, which included laying a cable through the factory, was expeditiously carried out by the British Thomson-Houston Company's engineers, and by 9.50 p.m. on the day on which the trouble occurred the supply was restored.

The London and North-Eastern Railway Bill.

ON Tuesday, June 16th, the London and North-Eastern Railway (General Powers) Bill came on for second reading in the House of Commons. Moving the rejection of the measure, Mr. R. Morrison said that two years ago, on a similar Bill, he initiated a discussion in regard to the inadequacy of travelling facilities in North London and urged, as he was still urging, that the London and North-Eastern Company was pursuing a dog-in-the-manger policy so far as London was concerned. Appeals had been made to the company to electrify its own lines or to withdraw its embargo, preventing anyone else from constructing a tube railway north from Finsbury Park Two years ago the company said it was considering the matter and it was still doing so. Sir E. Hume Williams explained that last year the railway company said it would either electrify its suburban lines or withdraw its veto and give way to the Metropolitan Railway or anyone else who wished to construct a tube. It abandoned the veto, but its action did not seem to have had any effect, as no tube had been constructed. Electrification would cost the company from £5,000,000 to £10,000,000, but it had not been oblivious to the complaints that had been made, for during the last year it had spent £1,193,000 on capital engineering work. The company had also appointed a special electrical engineer and a staff, but the work could not be done in a day or even a year. The present Bill only contemplated the creation of about fourteen miles of railway, which involved an expenditure of £1,200,000, and it would be foolish to refuse a second reading simply because the company had not been able to electrify its lines. On a division the second reading was carried by 274 votes to 127.

Diverting the Thames.

ANOTHER fantastic idea of utilising the river Thames for relieving the streets of London of some of their traffic has been put forward and was, let us hope, forthwith squashed when the Minister of Transport on Tuesday told Colonel Burton that he had not considered the advisability of diverting the Thames to a route through South London. The proposal was to make a straight cut from a point somewhere about Vauxhall to the Tower Bridge and to turn the river into this channel. The old bed would then be drained, reclaimed and laid out with streets and building sites, while the existing bridges would be left to facilitate cross traffic. The proposer admitted that the work would be great, but he appears to have overlooked a number of insuperable objections. The wharfage on the river front is already inadequate, and the scheme would reduce it enormously. The straight cut would have lowered the water in the upper reaches of the river, and all the existing culverts and drains would have to be extended to the new channel. In fact, the whole idea is so impracticable that it is difficult to imagine how anyone could put it before Parliament.

Unemployment.

ENDEAVOUR to discount it how we may, the great increase in unemployment which is shown by the latest returns of the Ministry of Labour is exceedingly disquieting. We may perhaps knock off a few thousands by considering the effect of the Whit-week holidays in the North, but we cannot get over the fact that in the first week of the present month there were well over a quarter of a million more persons unemployed than in the corresponding week of last year. It is also to be observed that out of the total increase of nearly 264 thousand, men suffer to the extent of practically 245 thousand. The decrease in employment is obviously due in considerable measure to the closing of coal mines, but that cause alone is not sufficient to account for the difference between the figures for last year and for this. It is common knowledge that no marked improvement has taken place in the iron and steel, shipbuilding and engineering industries, and until an upward movement takes place in them it will remain impossible to record a real improvement in the position. Out of the total number of seventeen million or so persons engaged in industries in this country over two million find occupation in the metal and machinery trades, and, with the exception of miners, they are suffering more than any others.

The Future of the Steam Engine.

THOSE engineers who, for more or less sentimental reasons, have deplored the supersession of the steam engine by the internal combustion engine, may take heart at the forecast of Dr. John S. Haldane, president of the Institute of Mining Engineers. At the annual meeting of the Institute, which was held in Cardiff on Tuesday, both Dr. Haldane and Sir John Cadman suggested that the present extensive use of oil fuel was only a passing stage, and that coal would reconquer many of the fields of utility which have been invaded by oil. As regards the relative merits of steam and oil engines, Dr. Haldane said that he believed steam engines would, in the not very remote future, take the place of internal combustion engines in many cases where internal combustion engines are now employed. In a steam engine jackets were, he said, used to conserve heat in the cylinders, but in an oil engine it was necessary to waste heat to keep the metal of the cylinders at a safe working temperature. The future development of the steam engine would be along the lines of higher pressures, with smaller boilers and lighter engines, so that in all probability they would be more suitable than petrol engines for aeroplanes and motor cars. He did not think that steam engines and internal combustion engines would ever fight, but believed that the steam engine would beat its competitor.

The British Steam Railway Locomotive from 1825 to 1924.

By E. L. AHRONS, M.I. Mech. E.

No. XXV.*

PERIOD 1870 TO 1875.

Express Engines with "Single" Driving Wheels.—During the period 1870 to 1875 only two railways, the Great Northern and the Great Western, continued the regular construction of engines with uncoupled wheels. To these there should be added the London, Brighton and South Coast Railway, on which single engines were not yet abandoned, except for the heaviest expresses, though only one engine of a new class was constructed at this time. The engines of all three railways were of different types.

The most notable of the new engines were P. Stirling's celebrated 4–2–2 "singles," with 8ft. driving wheels, outside cylinders and leading bogies—Fig. 196. These engines may be described

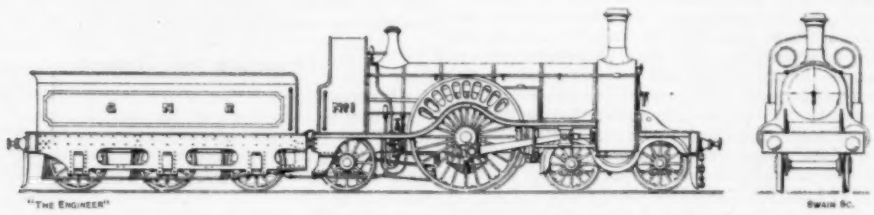


FIG. 196—P. STIRLING'S EXPRESS LOCOMOTIVE, G.N. RAILWAY, 1870

as one of the boldest departures made at that time from what was then considered orthodox practice. Stirling had always been an advocate of single engines, and in 1866, immediately before his departure from the Glasgow and South-Western Railway, had constructed six-wheeled engines of that type with outside cylinders and 7ft. driving wheels, though he subsequently returned to inside cylinders in his first Great Northern engines of 1868. For the new and more powerful engines he chose the large driving wheel diameter of 8ft. 1in., on the ground that the larger the wheels the better their adhesive grip on the rails. Owing to the use of 80 lb. steel rails on the main line, the weight on the driving wheels was brought up to 15 tons. But the use of such large wheels compelled the designer to use outside cylinders, and these were the only engines constructed by him for the Great Northern in which that position of the cylinders was adopted. Each cylinder was held in an opening in the frame, which was closed below by means of a piece formed like a hornplate stay. The steam chests were vertical and placed inside the frames. The cylinders, 18in. bearings, each consisting of a channel-shaped bracket which embraced the bogie frame. The main frame, which, when the bogie was central, lay in the same vertical plane as the bogie frame, rested on a sliding foot which could move laterally inside the channel of the bracket. The diameter of the bogie wheels was 3ft. 11in. and of the trailing wheels 4ft. 1in.; engine wheel base, 6ft. 6in. + 7ft. 9in. + 8ft. 8in. = 22ft. 11in. The trailing axle had ¾in. lateral play in the horn blocks, and the weight at that end was carried on volute springs.

The boiler was of the domeless type, with an internal steam collecting pipe, and was pressed at 140 lb. per square inch. It was of Lowmoor iron and contained 217 brass tubes, $1^{9}/_{16}$in. diameter. The fire-box had a transverse inclined copper water mid-feather instead of a brick arch, which, in effect, was somewhat similar to the French Ten-Brinck arrangement, but extended from side to side between the water spaces, instead of being connected to the latter by bent pipes. This arrangement, which was subsequently abandoned for the usual British type of brick arch, increased the fire-box heating surface to 122 square feet. The total heating surface was 1165 square feet, and the grate area 17.6 square feet; weight in working order, on front bogie wheels 7 tons, hind bogie wheels 8 tons, driving wheels 15 tons, trailing wheels 8 tons 9 cwt., total 38 tons 9 cwt.

These engines were not built in batches of ten or more, as is the usual practice. They came out from the works at intervals, one or two at a time, beginning with the first engine, No. 1 of 1870. By the end of 1875 only twelve were in service, though at the end of 1895 there were fifty-three of the type. They performed by far the greater part of the main-line express service until the end of the nineteenth century, but in the later years they shared the work with another type of single engine to be mentioned subsequently. There were modifications in details in the later 8ft. engines, which it will be convenient to mention here. From about 1884 the trailing wheels were increased to 4ft. 7½in. diameter, and the cast iron footplate was replaced by a built-up structure of plates and angle irons. The driving axles were strengthened, the diameter of the main bearings being increased from 8in. to 8½in., and helical springs were substituted for the plate springs of the first design, but the volute springs at the trailing end were replaced by plate springs. The boiler barrel was slightly enlarged, and 174 1¾in. tubes replaced the 217 $1^{9}/_{16}$in. tubes originally used. The total heating surface was, however, decreased to 1045 square feet, of which the fire-box supplied 109 square feet. The pressure was raised to 160 lb. The weight in working order, considerably increased owing to the general strengthening of the detail parts, became:—On front bogie wheels, 8 tons 2 cwt.; hind bogie wheels, 9 tons 9 cwt.; driving wheels, 17 tons; trailing wheels, 10 tons 12 cwt.; total, 45 tons 3 cwt.

The cylinders, it may be noted, remained 18in. by 28in. as before, though in many of the engines they were in course of time bored out to 18¼in. and 18½in. diameter, and all the engines, forty-seven in number, built until the end of 1893, had, when new, the standard 18in. cylinders.[1] The last six engines of 1894–5 were of increased dimensions, and will be referred to in due course.

Perhaps the most noticeable feature, apart from the 8ft. driving wheels, was the great simplicity of the design. To their excellent performances on the road, the writer hopes to refer later.

The Great Western design of 1873–5 by Joseph Armstrong was a further enlargement of Stephenson's double-framed 2–2–2 type. The first of these engines, built at Swindon in 1873, had a domed boiler. It was named Queen, and was used for several years to haul the Royal trains. The twenty subsequent engines of 1875 had domeless boilers, and the fire-boxes were stayed directly to the casings. Following Sir Daniel Gooch's old practice, a transverse midfeather divided the grate into two portions, and there was also a water pocket across the top. Both ⅜in. inside and ⅝in. outside frames were of iron, and extended from front to back buffer beams.[2] The wheel base, 8ft. 6in. + 9ft. = 17ft. 6in., was exceptionally long, and resulted in a very steady engine at high speeds. The following were the leading dimensions:—Cylinders, 18in. by 24in. at 2ft. 6½in. centres; steam ports, 1ft. 4in. by 1¾in.; exhaust ports, 1ft. 4in. by 3½in.; driving wheels, 7ft.; carrying wheels, 4ft. diameter; the boiler, 4ft. 3in. diameter outside, was of $^{7}/_{16}$in. Lowmoor plates, and contained 250 1¾in. tubes, giving a heating surface, of 1145.5 square feet; fire-box heating surface, 133 square feet, including the surfaces of water pocket and partition; total, 1278.5 square feet; grate, 18 square feet; pressure, 140 lb.; weight in working order, 33½ tons, of which 14 tons rested on the driving wheels. The outside bearings of the driving axle were 6in. diameter by 9in. long, and the inside bearings 7in. diameter by 6in. long; carrying wheel bearings, in outside frames only, were 5in. diameter by 10in. long; the driving springs were underhung.

When these engines were rebuilt by Mr. Dean in 1884–7 with domed boilers, the steam ports were reduced to 1ft. 3in. by 1¾in., and the exhaust ports enlarged to 4in. wide. The grate area was increased to 19½ square feet by the omission of the midfeather. The weight was raised to 34 tons 12 cwt., of which 14½ tons were carried on the drivers. These engines worked many of the fastest standard gauge expresses until the end of last century.

Stroudley's express engine—Fig. 197—of 1874 for the L.B. and S.C.R., with inside cylinders, had inside frames and bearings only, and in this respect followed the design of McConnell's "Bloomers." The dimensions form an interesting contrast to those of the G.W.R. engines dealt with above. The cylinders, 17in. by 24in., were placed at 2ft. 2in. centres, the difference being principally due to the necessity for long bearings for the driving axle in the inside frames. The ports were 1ft. 3in. long, the width of thesteam ports being 1¾in. and of the exhaust ports 2in. Driving wheels, 6ft. 9in.; carrying wheels, 4ft. 6in. diameter; wheel base, 8ft. + 7ft. 9in. The frames were 1in. thick; the driving axle bearings were 8in. diameter by 8in. long, and the carrying axle bearings 7in. diameter by 8¾in. long. The driving springs were of the volute pattern. The slide bars were trough shaped, and the connecting-rods of circular section.

FIG. 197—STROUDLEY'S EXPRESS LOCOMOTIVE, L.B. AND S.C. RAILWAY, 1874

FIG. 198—KIRTLEY'S EXPRESS LOCOMOTIVE, M.R., 800 CLASS RE-BUILT

diameter by 28in. stroke, were horizontal, and to avoid the cylinder overhang and short wheel base, compulsory in a six-wheeled engine, a leading bogie was employed. Its wheel base was 6ft. 6in. There was no question of introducing the bogie in order to improve the "curving" property of the engine, for the Great Northern has a very straight main line. Stirling had no great affection for leading bogies, and the 8ft. singles were the only locomotives with them which he ever built. The bogie was of the rigid centre pin pattern, without lateral movement, but the pin, instead of being placed midway between the front and hind axles, was behind the centre line, and divided the bogie base into 3ft. 6in. + 3ft. With this arrangement the leading wheels followed the curve better with less tendency for the main frame to pull the bogie back towards the outside, and, further, the weight coming on to the rails was increased progressively. As Mr. Stirling subsequently expressed it, the bogie gradually laid down the road so that the driving wheels got hold of it. The pivot carried only a very small proportion of the load, most of which was supported on two side

The boiler had an external diameter of 4ft. 5in., and contained 206 1¾in. tubes, which provided 1022 square feet of heating surface. Total heating surface, 1132 square feet; pressure, 150 lb.; total weight, 33 tons, of which 14 tons were carried on the driving wheels. Fig. 197 shows the engine at a later period of its existence, with an inside-framed tender of the 1880 design. As originally built, it had wooden brake blocks applied to the front of both driving and trailing wheels, actuated by both steam and hand brakes.

Between 1880 and 1882, twenty-four similar engines, but with smaller driving wheels—6ft. 6in.—were built at the Brighton works. They were used on the lighter Brighton expresses, and also worked nearly all the trains between London and Portsmouth.

Single v. *Coupled Express Engines.*—The appearance, followed by the great success, of Stirling's Great Northern 8ft. single engines brought into prominence the respective merits of single and four-coupled engines for express trains, and for many years an animated discussion on the subject took place. No locomotive engineer of that day would have em-

* No. XXIV. appeared June 12th.

[1] Drawings and a large plate illustration of these G.N.R. engines of the 1884–1893 period appeared in THE ENGINEER, December 16th, 1892.

[2] For drawings see THE ENGINEER, September 22nd, 1876.

ployed a coupled express engine had he been convinced that a single engine was always reliable. P. Stirling, J. Armstrong, and others decided that the latter was equally reliable, and under the conditions of that day they were probably right. Certainly the Great Northern 8ft. singles took loads on express trains of greater weight and at faster speeds than those on any other railway, and they never, until the end of the century, took a pilot engine. In 1867–8 Mr. Stirling built both 2–2–2 and 2–4–0 engines for express work. The cylinders in both classes were 17in. by 24in., the boilers were of equal power, and the only difference of importance lay in that the single engines had 7ft. 1in. driving wheels, whereas those of the coupled engines were 6ft. 7½in. The coupled engines were therefore nominally more powerful when considered from the tractive force standpoint alone. Mr.

FIG. 199—KIRTLEY'S EXPRESS LOCOMOTIVE, MIDLAND RAILWAY 800 CLASS, 1871

Stirling himself stated that his experience of these two classes showed that with trains of equal weight the single engine was the better, and that even on the long uphill pull of 12¾ miles from King's Cross to Potter's Bar, beginning with a 2 mile rise of 1 in 105, and the remainder mostly at 1 in 200, the single engine "had the best of it." Subsequently the same celebrated engineer expressed the matter tersely in saying that "a coupled engine was like a laddie running wi' his breeks doon."

The late Charles Rous-Marten, in a report dated 1887, based on train timings made during 1884–5, stated that with trains of 200 to 240 tons the 8ft. single engines never took more than 12¼ minutes for the 8 mile rise of 1 in 200 to Potter's Bar, even with the heaviest loads. He also compared the work done by these engines, the tractive force of which was 93.6 lb. per pound of effective pressure, with that of the coupled engines, with 6ft. 7in. driving wheels and 17½in. by 26in. cylinders, having a tractive force of 100.8 lb. per pound, and found that with equal loads of 15 six-wheeled coaches the former ascended the 15¼ mile bank, Tallington to Stoke signal-box, of which 8 miles rise at 1 in 200 and 1 in 178, in 21 minutes, as against 22¼ minutes taken by the coupled engine. In both cases the boiler pressure was 140 lb., but the heating surface of the 8ft. single engine was 5¼ per cent. and the cylinder volume, neglecting clearance, was 10¾ per cent. greater than that of the coupled engine.

When the Midland main line from Leicester to Hitchin was opened in 1858 and the trains of that company ran through to King's Cross, a few 2–4–0 express engines with 6ft. 6in. driving wheels were specially built for the service. These engines had what was not an uncommon defect in those days; they bent, and not infrequently threw, their coupling rods. They subsequently had to be converted to single engines. Similarly, Sturrock's 7ft. coupled express engines of 1866 had the same failing, and P. Stirling likewise rebuilt them as "singles." The causes are not far to seek. In 1858–1861 both tires and rails were of iron, and the soft material wore unevenly, so that it was not very long before the coupled wheel tires had worn down unequally. The driving wheels were trying to drag the trailing wheels round faster than their normal rolling speed with the consequent stress on the coupling rods.

The writer also considers that in some cases defective balancing probably contributed to the cause of the trouble. Admitting that the revolving masses may have been correctly balanced, which in many cases is doubtful, it was usual to balance a very large proportion of the reciprocating masses. D. K. Clark, following Le Chatelier, gave rules, in which the whole of the reciprocating masses was balanced, though he recommended a distribution of this portion of the weight between the coupled wheels. At a later date, three-quarters of the reciprocating weight were balanced, but for some reason the whole of the balance weight corresponding to these masses was placed in the driving wheels alone instead of being distributed. The writer has records of engines which in 1875 were balanced in this way. Though it is true that the lighter and less massive engines of those days required the balancing of a larger proportion of the reciprocating masses than is necessary for heavy modern engines, nevertheless there was too great a variation of rail load, estimated as a percentage of the static weight on the driving wheels, which was then only about 11 to 13 tons. The result of this variation may be slight slipping through part of a revolution of the wheels, thus producing flats on the driving tires, and thereby throwing further stress on the coupling rods. Other things being equal, and within the limits of the adhesion available, the coupled engine gave a lower ratio of effective to indicated horse-power than the "single." In addition, there was the expense of and loss in re-turning the tires of two pairs of wheels to the diameter of the smallest wheel, a point of considerable importance owing to the comparatively rapid wear of the soft tires.

Amongst the very few successful coupled express locomotives of the 1860–1866 period, J. Beattie's L. and S.W.R. engines, with 7ft. wheels, may be mentioned. The first three, built in 1859, had wrought iron tires, but in 1863 Beattie adopted steel tires and fitted them to these and the subsequent engines of 1864–8.

As tire material became harder, and the balancing was improved, the difference between the tractive efficiency of the two types of engine decreased, though it never disappeared. The writer knows of no exact test made in this country to ascertain the comparative resistance of single and four-coupled engines of equal power and similar dimensions. About 1887 Mr. James Holden, on the Great Eastern Railway, removed the coupling rods from a 2–4–0 express engine with 18in. by 24in. cylinders and 7ft. driving wheels, and worked it on express trains in that condition, with the result that he subsequently (1888–1893) constructed a number of single engines of similar dimensions. Experiments made in Germany by F. Leitzmann by removing the coupling rods from a 4–4–0 compound express engine with 6ft. 6in. driving wheels, and allowing it to "coast" down a gradient of 1 in 200 without steam, showed that the coupling rods were responsible for 20 per cent. of the total frictional resistances of the engine. Starting from rest the coasting speeds attained, when acceleration ceased, were 24.8 miles per hour for the coupled, and 31.7 for the uncoupled engine. Leitzmann pointed out that the influence of coupling rods at higher speeds would be much greater owing to the increase in the dynamic forces produced. These experiments took place at about the end of last century, when tires were harder than was the case thirty years before, and it is very probable that the proportion of frictional resistance due to coupling rods was at one time greater than 20 per cent.

Apart from the G.N.R., G.W.R., and L.B.S.C.R., many other main lines, such as the Great Eastern, South-Eastern, Caledonian, &c., used single engines almost exclusively for their best expresses, and on the London and North-Western south of Crewe the majority of trains were worked by them until about 1878-1880. The Midland, which had heavier gradients, used coupled engines exclusively on the main line expresses, and built no singles from the early part of 1866 to the latter part of 1887. The booked speeds of the fastest trains on that line between Bedford and Leicester from 1866 to 1874 were 45 to 45¾ miles per hour. On the North-Eastern the East Coast Scotch expresses were worked between York and Edinburgh by coupled engines, though the gradients for the greater part of the road are comparatively easy. These were the same trains which were hauled between London and York by the Great Northern single engines at higher speeds over a considerably heavier road.

There was no steam sanding apparatus until 1886; the lack of adhesion, when starting trains of 150 tons and over in slippery weather, made itself felt after 1880, and in the winter months of the 1880–1886 period the singles were sometimes unreliable. The steam sand blast subsequently gave the type a new lease of life, as will be mentioned later. But by that time the rails had become heavier and the road generally improved so that considerably more weight could be allowed on the driving wheels.

Coupled Express Engines, 2–4–0 Type.—Space permits of the mention of only certain of the more prominent engines which either had excellent reputations or possessed certain features to which attention may usefully be directed. In the front rank were M. Kirtley's celebrated Midland engines, 800 class, with 6ft. 8in. coupled wheels and outside bearings throughout. There were forty-eight of the class, twelve built at Derby in 1870–1, and thirty by Neilson in 1870. As originally constructed with 17in. by 24in. cylinders, 1097 square feet of heating surface and 140 lb. pressure, they were mentioned and illustrated by the writer in THE ENGINEER of December 1st, 1922. Although their dimensions were in no way out of the ordinary, other than that the outside plate frames allowed extra bearing area for the driving axle, and that the cylinder centres were spread out to 2ft. 6in. instead of the usual 2ft. 4in. or thereabouts, for inside-framed engines, their excellent work decided S. W. Johnson in 1875–6 to use them for the heaviest Scotch and other expresses between London and Carlisle, and to this end he provided them with new 18in. by 24in. cylinders (eleven engines 18in. by 26in.) and larger boilers. The latter contained 223 1¾in. brass tubes, of which the heating surface was 1115 square feet; total heating surface, 1225 square feet; grate area, 17½ square feet. The original weight of 36 tons 3 cwt. in working order was increased to about 40½ tons. The original frames and motion were retained. The thickness of the outside frames was 1¼in., and of the inside frames ⅞in. Some of these frames are still in service. Fig. 198 shows No. 815, one of the class as rebuilt. Incidentally, this was the engine which ran from Carlisle to Aisgill summit, 48¼ miles, in 59 min. with a load of 130 tons, a total rise of 1100ft., the last 11 miles at 1 in 100.

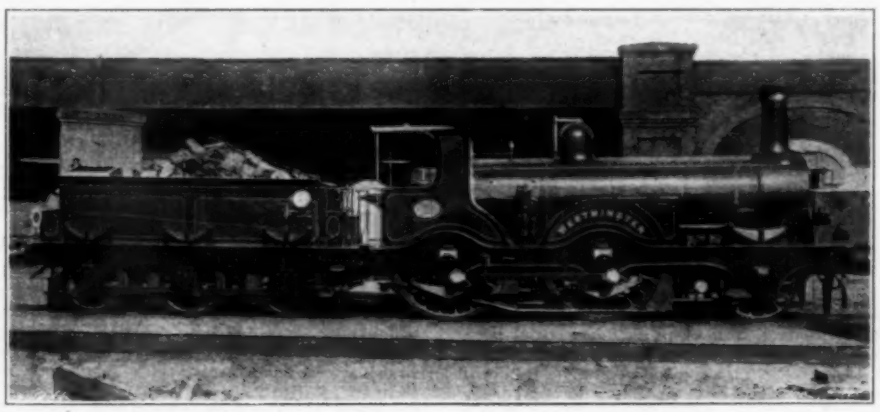


FIG. 200—STROUDLEY'S EXPRESS LOCOMOTIVE, L.B. AND S.C. RAILWAY, 1872–5

There was one valuable characteristic of all the rebuilt engines of the 800 class; they would stand a great deal of what the drivers used to term "hard thumping," *i.e.*, they could be worked for considerable distances with heavy trains with the lever well down and a late cut-off, without running themselves "out of breath." There were on the same railway other excellent engines with the same boiler and general dimensions—also rebuilt with 18in. by 24in. cylinders—but with the difference that the driving bearings were inside and the cylinder centres 2ft. 4in. apart. The latter engines had an offset of 1¼in. in the valve spindles, as compared with only ¼in. in the 800 class. The steam chest space of the 800 class was wider than that of the inside-framed engines. The writer does not definitely know the port areas of the 18in. cylinders of the rebuilt engines, but at that time (1876–1882) S. W. Johnson's standard 18in. cylinders had ports 15½in. by 1¾in. and 3½in. Further, no indicator diagrams exist, and in the absence of them it is impossible to give definite reasons for the special qualities shown by the two types. The rebuilt inside-framed engines, also with 18in. by 24in.

cylinders, though they did excellent work, could certainly not stand the continuous "hard thumping" which the 800 class seemed to bear with comparative ease. It is tentatively suggested that the larger steam space in the valve chest, which in both classes was placed vertically between the cylinders, may have had a great influence. The motion being of similar dimensions, there would be no reason for a different valve setting.

The second type of Midland express engine, the 890 class, which had inside bearings for the coupled axles—Fig. 199—is that which, in its subsequent rebuilt state, has been referred to above. Of these engines the first twenty by Neilson, 1871, were the prototypes of the numerous 2–4–0's still at work on the line, and were the first Midland engines to be provided with cabs. The cylinders were 17in. by 24in.; wheels, 4ft. 2in. leading and 6ft. 8½in. coupled; wheel base, 8ft. + 8ft. 6in., which was standard for all Midland six-wheeled engines from 1860 onwards, other than those of the 2–2–2 type. The leading axles of both these and of the previous 800 class had outside bearings, the axle-boxes having ¼in. lateral play in the horns on each side of the centre line, but without any controlling arrangement, such as inclined planes. This simple method of providing flexibility was characteristic of most of the company's 2–4–0 engines of this type, and was successfully used until 1881. The springs of the coupled wheels were connected by compensating levers, but these were removed about 1875–6. The boilers, 4ft. 1in. diameter inside, contained 232 1½in. tubes, which provided 1028 square feet of heating surface; total heating surface, 1122 square feet; pressure, 140 lb.; grate area, 16 square feet; weight in working order, leading, 11 tons 0 cwt. 3 qr.; driving, 12 tons 17 cwt.; trailing, 12 tons 14 cwt. 3 qr.; total, 36 tons 12 cwt. 2 qr.

Thirty-six similar engines were built at Derby, 1872–4, with the only difference in dimensions that the boilers had 188 2in. tubes, which gave practically the same amount of heating surface. The question of tube diameter, to which much attention was devoted between 1870 and 1880, will be referred to subsequently.

It may be of interest to add that when the Midland Railway introduced Pullman cars into this country in 1874 the complete Pullman trains were worked between Leeds and St. Pancras by the 890 class, as illustrated. For this purpose the tenders were fitted with central buffers of the American pattern. Two years later, when the complete trains were split up and the coaches used in the ordinary Scotch and other expresses, they were provided with British side buffers, and the central buffers were removed.

Another successful series of very similar coupled express engines was the 901 class of the North-Eastern Railway, designed by E. Fletcher. These engines, which worked all the East Coast Scotch express trains between York, Newcastle and Edinburgh, first appeared in 1872, and fifty-five of them were built between then and 1882, thirty-five at Gateshead works, ten by Beyer, Peacock, and ten by Neilson. The cylinders of those built in 1872–1876 were 17in. by 24in., placed at 2ft. 4½in. centres. The later engines of 1880–2 had 17½in. by 24in. cylinders. The coupled wheels were 7ft. and the leading wheels 4ft. 6in. diameter; wheel base, 8ft. 4in. + 7ft. 9in. The boiler, with 254 $1^9/_{16}$in. tubes, had a total heating surface of 1208 square feet, of which the fire-box provided 98.5 square feet; grate area, 16.1 square feet; pressure, 140 lb.; weight in working order, leading, 12 tons 8 cwt.; driving, 14 tons 3 cwt.; trailing, 12 tons 18 cwt. The leading axle-boxes had some lateral play in the horns, as in the Midland engines, and to diminish the tendency to cant and cause uneven wear owing to non-central spring pressure, the leading journals were 1ft. long. The tires had a width of 6in. The reversing gear was of the combined lever and screw type, the lever being on the outside of the screw with the usual trigger, so arranged that the nut engaging with the screw could be lifted out of gear when quick reversing was necessary. The ports were 15in. by 1¼in./3¼in., and the valves had 1¼in. outside lap, and $^1/_{16}$in. inside lap; maximum travel about 4¼in. For 2–4–0 engines of the period they were heavier than usual, partly on account of the large boilers and partly owing to the inside frames, which were 1¼in. thick. The first engines, built before the adoption of a continuous brake, had wood brake blocks on the coupled wheels actuated by hand. In this respect they were amongst the earliest examples of express tender engines with engine brake power.

Stroudley's first coupled engines of 1872–5 for the Brighton Railway—Fig. 200—differed completely from the later types with which his name has generally been associated. The former had double frames and the driving was coupled to the trailing, instead of to the leading axle. The outside springs of the coupled wheels were underhung. The dimensions may be compared with those of the engines described above. Cylinders, 17in. by 24in., placed with centres 2ft. 6in. apart as in the double-framed Midland engines; leading wheels, 14ft. 1in.; coupled wheels, 6ft. 6in. diameter; wheel base, 8ft. 4in. + 8ft. 4in.; the total heating surface varied from 1234 square feet in the first engines with 260 1¼in. tubes, to 1123 square feet in the later engines with 206 1¾in. tubes. Owing to boiler differences, the total weight of the first engines was 41 tons 4 cwt., of which 15 tons rested on the driving and 13 tons 4 cwt. on the trailing wheels, but the later engines had a total weight of 39 tons 3 cwt., the load on the trailing wheels being 11 tons 1 cwt. The former were the heaviest 2–4–0 engines of their day, the load on the driving wheels being exceptional. The outside cranks had a shorter throw than the inside cranks, and were placed on the same side of the axle, both features being in accordance with Stroudley's usual practice. Until 1880–1, these engines worked the heavy "business" expresses between Brighton and London Bridge.

IT is said that the Lopulco pulverised fuel plant which is to be supplied for the St. Maurice Lumber Company by International Combustion, Ltd., will be the largest in the Empire. It is to work in conjunction with four Babcock boilers, each having 10,470 square feet of heating surface.

The Littleton—Queen Mary—Reservoir and Works.

No. I.

ON Saturday of last week, his Majesty the King, who was accompanied by the Queen, formally inaugurated the Queen Mary Reservoir and the works of the Metropolitan Water Board at Littleton. This reservoir is, we believe, the largest artificial reservoir of its kind in the world, as distinct, that is, from a reservoir formed by a dam built across a river or a mountain gorge. It is formed entirely by an encircling earth embankment with a central wall of puddled clay. It is difficult, even when viewing it from the top of its embankment, to form an adequate conception of the magnitude of this huge artificial lake, but some idea may be gained from the facts that (*a*) the embankment is about 4 miles in perimeter, and (*b*) that the water surface at top water level will be 723 acres in area, which is nearly 90 acres more than the combined areas of Hyde Park and Kensington Gardens, is but little less than the area of Thirlmere, and almost exactly the same as that of Hawes Water, from which Manchester is about to obtain an additional supply of water. It will contain, with the water at top level, no less than 6750 million gallons of water. That quantity represents the contents of a channel 400 miles long—say, a canal between London and Glasgow

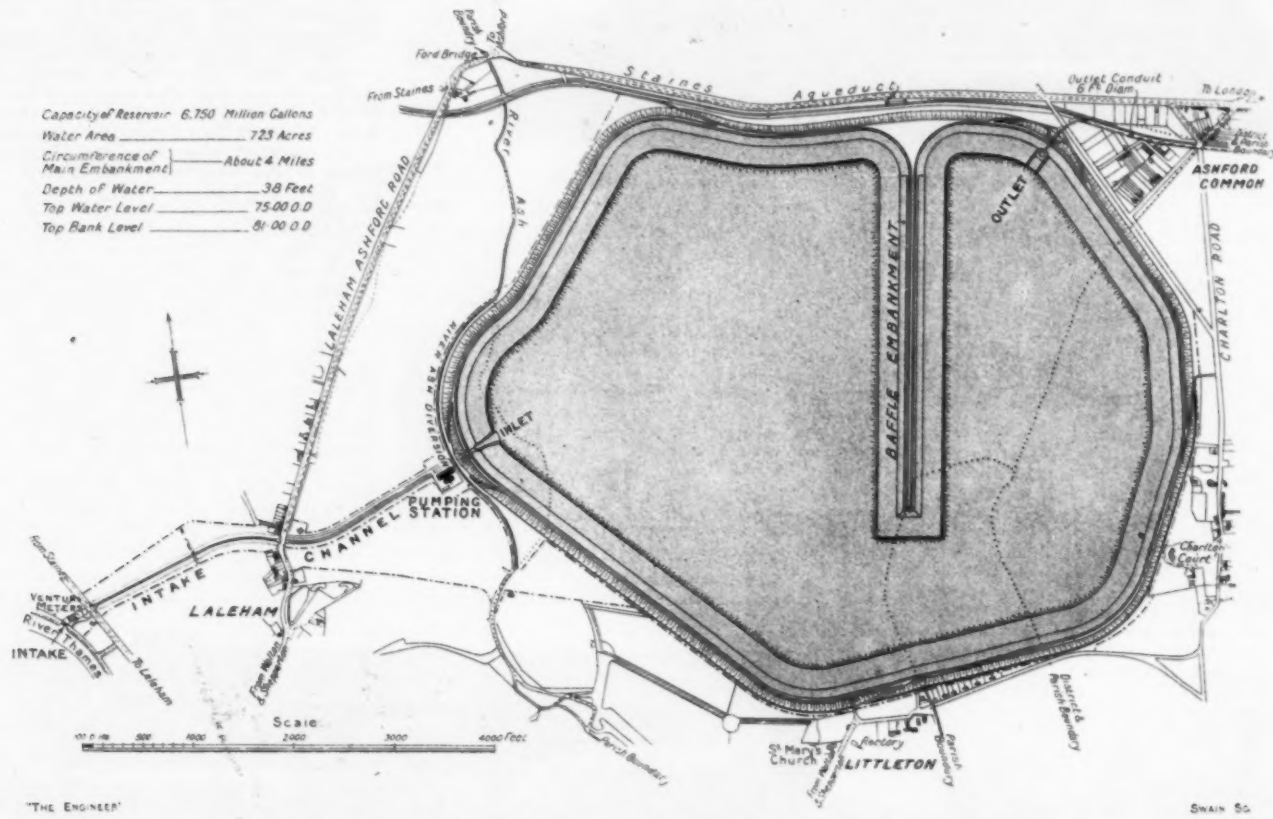


FIG. 1—PLAN OF THE QUEEN MARY RESERVOIR, SHOWING INTAKE CHANNEL AND PUMPING STATION

Powers to construct the reservoir and its accessory works were granted by an Act of Parliament passed in 1911, when the late Mr. W. B. Bryan, M. Inst. C.E., was the Chief Engineer. The work of construction was begun in 1914, Dick, Kerr and Co., Ltd., being the contractors. Owing to the war, operations were at first much interfered with and finally stopped altogether in February, 1916, the contract being terminated. For more than three years nothing was done, but in July, 1919, a further contract on the basis of cost plus a lump sum was entered into with S. Pearson and Son (Contracting Department), Ltd., which has now completed the undertaking. As originally designed, there were to be two reservoirs, each of approximately 3500 million gallons capacity, separated by an embankment running from north to south. It was the original intention, when parliamentary powers for the construction of the Littleton

By the courtesy of Mr. Henry E. Stilgoe, M. Inst. C.E., the Chief Engineer of the Water Board, who has given to us every facility for inspecting the works and has supplied us with the drawings and photographs from which the illustrations accompanying this article have been prepared, we are enabled to give our readers the following particulars of this, the most important work hitherto brought to completion by the Board.

—50ft. wide and nearly 10ft. 3in. deep. Taking the daily consumption of water in London at 250,000,000 gallons in round figures, it would furnish just twenty-seven days' supply. In plan the reservoir has the shape shown in Fig. 1. The greatest length, from west to east, is some 7300ft., or just over 1.38 miles, and the greatest width, from north to south, is about 5700ft., or 140 yards more than a mile.

Reservoirs were obtained in 1911, to convey the water from these reservoirs to Staines, where it was to be filtered and pumped through a new main to service reservoirs at Horsenden Hill, near Sudbury, and to Barn Hill, near Wembley. It was later determined, however, to convey the water from those reservoirs by means of a conduit to the Board's works at Kempton Park, and, after filtration there, to pump it through a main to be laid parallel with an existing main to the proposed service reservoirs. Parliamentary powers for the altered works were obtained in the Metropolitan Water Board (Various Powers) Act of 1913. Mr. Bryan was responsible for the altered scheme of 1913 as he had been for that of 1911, and the contract plans were prepared under his direction. He, however, only lived for some two months after the work had been begun.

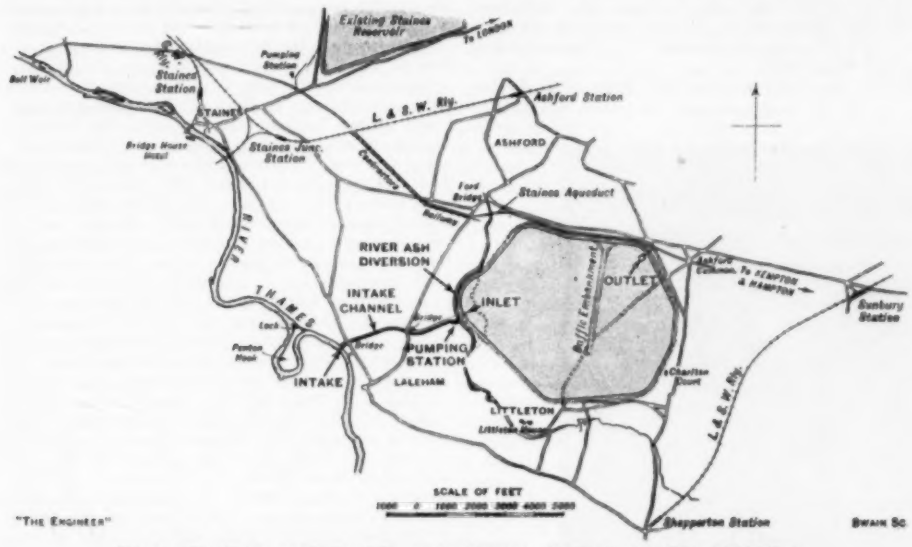


FIG. 2—KEY PLAN SHOWING THE GEOGRAPHICAL POSITION OF THE RESERVOIR

The pumping station in the original proposal was to be situated at the junction of the central division between the two reservoirs and the southern embankment, and the water was to be delivered into one or other or both the reservoirs at will through twin inlets. At that time it was not proposed to submerge the northernmost part of the small village of Littleton, which consisted of a handful of picturesque old cottages, some of them very old, and the line of the north-western embankment ran considerably further to the west than does the embankment of the present structure. Subsequently, under the *régime* of the late Sir J. W. Restler, who followed Mr. Bryan as Chief Engineer to the Board, it was decided to omit the dividing wall and to form a single reservoir having two baffle embankments parallel with one another to provide for the circulation of the water and to break up the wave action which is bound to occur in such a large body of water. One baffle embankment was to start from the southern main embankment and run north, while the other was to start from the northern main embankment and run south, but neither was, of course, to reach the opposite side. At the same time it was determined to shift the position of the inlet from the junction of the dividing and the southern embankments of the reservoir to a site near the south-western corner; that is to say, to approximately the position occupied by the present inlet. The outlet was—except in the original parliamentary scheme, by which the water was to be taken from the reservoir to Staines—in all modifications of the original idea, approximately in the position occupied by the present outlet—in the north-east corner of the reservoir. With the two baffles the water passing from the inlet to the outlet would have been forced to take a zig-zag course. Still later, Mr. Henry E. Stilgoe, the present Chief Engineer, owing to the presence of running sand of considerable depth under the western embankment, advised the curtailing of the reservoir on that side and its extension to the south, and parliamentary powers for this alteration were obtained under the Board's (Various Powers) Act, 1921. This variation involved the omission of the western baffle embankment. The outlet conduit, filter beds, pumping station, engines, mains, &c., did not form part of the original contract, and they had, in fact, not been designed when it was let. Sir James Restler did not live to superintend the carrying out of the work, for he died suddenly in November, 1918. He was succeeded in 1919 by the present Engineer, Mr. Henry E. Stilgoe, under whose supervision the works were carried out and completed. The alterations

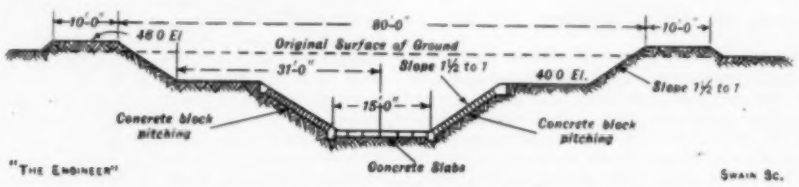


FIG. 3—TYPICAL CROSS SECTION OF INTAKE CHANNEL

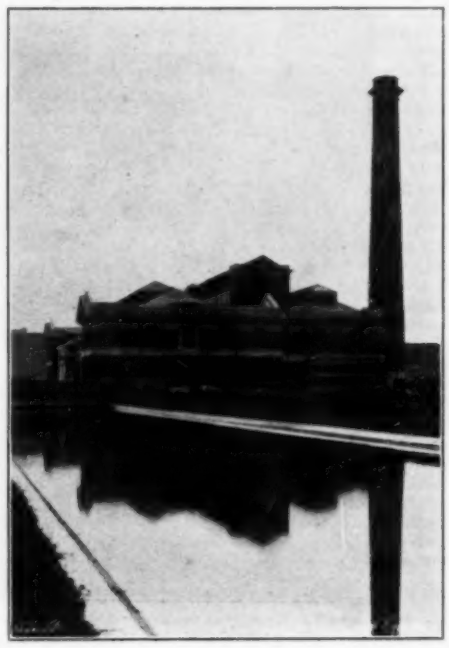


FIG. 5—PUMPING STATION AND TERMINATION OF INTAKE CHANNEL

initiated by Mr. Stilgoe involved the submergence of the group of cottages referred to above and they had accordingly to be replaced by modern dwellings, erected just outside the reservoir embankment, which, though certainly not so picturesque as the homes they superseded, must undoubtedly be more convenient. The same rentals were paid for them as had been paid for the original cottages.

Neither Mr. Bryan nor Sir James Restler had put forward any detailed scheme for dealing with the distribution of the water, and Mr. Stilgoe, on taking office, had to give the matter his consideration. The result of his investigations was the presentation to the Board in October, 1920, of a report on "Future Supplies of Water to the Metropolis." The principal features of his proposals, so far as the water to be derived from the reservoir at Littleton was concerned, had reference to the conduit from Littleton to Kempton and Hampton, the filtration works, pumping station and machinery at Kempton, the abandonment of the proposed reservoirs at Horsenden

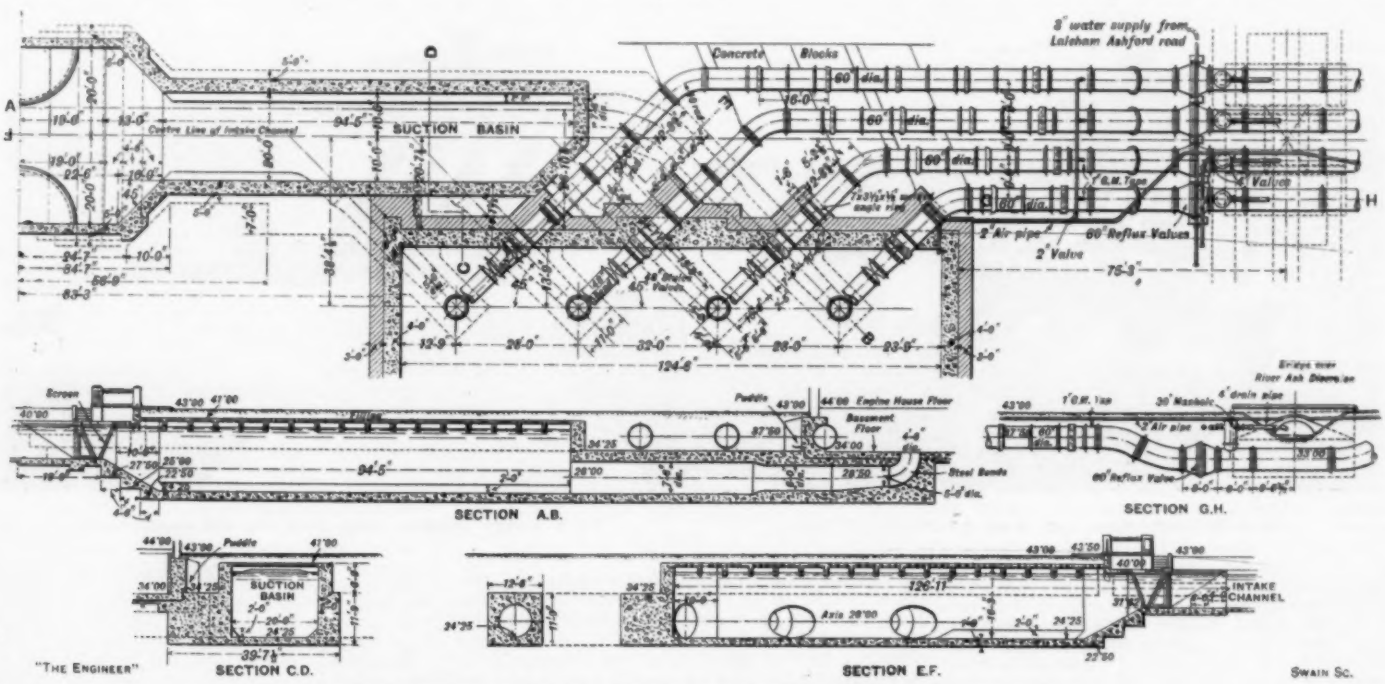


FIG. 4—ARRANGEMENT OF SUCTION CONDUITS AND DELIVERY PIPES AT PUMPING STATION

Hill and Barn Hill, and certain aqueducts connected therewith, the construction of service reservoirs at Highgate, the continuation of the proposed main from Cricklewood to the new reservoirs at Highgate, and to the existing and proposed new reservoirs at Fortis Green, and the laying of trunk mains from Cricklewood to the Marble Arch, to the New River Head and to Holloway to connect with the Maiden-lane, Claremont-square and Crouch Hill zones. These and other works, including the powers to alter the line of the embankment of the reservoir, were embodied in the Board's Act of 1921. Since the passing of this Act contracts have been entered into for the construction of the conduit from the Littleton Reservoir to Kempton and Hampton, for the pumping station buildings, and pumping machinery at Littleton and at Kempton, and for the laying of the various mains, &c., which form a necessary corollary of the Queen Mary Reservoir.

From the engineering point of view, no site could have been better suited for the construction of a reservoir of the kind than that chosen at Littleton. The whole area, saving for undulations, was very nearly level, and under the whole of it was the impervious London clay. It is true that the clay was found at varying depths from the surface, which rendered it necessary to take the foundation of the core wall deeper in some places than in others, but the clay was there throughout and never at an entirely prohibitive depth, though, at one place, we understand, the puddle trench had to be taken down to 55ft. below the original surface of the ground before sound clay was reached. Furthermore, the soil to be removed was of a suitable nature and amply sufficient to provide filling material for the embankment, there was a plentiful supply of first-class ballast in the subsoil to make all the concrete required on the work, and the London clay under the ballast, after weathering and treatment in pug mills, formed excellent puddle. Those who lived on the site of the reservoir and in the surrounding districts, however, must, we fear, have considered it little short of sacrilege to carry out an engineering undertaking of the magnitude and character of the present reservoir in their neighbourhood. The site covered included some delightful rural country, and it was necessary to destroy a great deal of woodland which is said to have been of very considerable beauty. Unfortunately, the demands of civilisation occasionally call for such sacrifices, but we cannot help feeling sorry for those who have been ousted from homes which, in some cases, at any rate, must have been in the possession of their families for very long periods.

As will be seen from the key map—Fig. 2—the reservoir lies between the villages of Laleham, Ashford and Sunbury, with Staines and its reservoirs farther away to the north-west. The aqueduct leading from the Staines reservoirs to Hampton passes close to and parallel for some distance with the northern embankment of the reservoir, and, as we shall show, arrangements have been made by which it is possible to deliver water from the reservoir into that aqueduct. In the actual construction of the reservoir, almost the only work called for, in addition to the formation of the core wall, the main and baffle embankments, and the levelling of the ground, was the diversion of the river Ash, a small stream, running approximately from north to south through the site, which, besides its own flow, carries the effluent from the Staines sewerage purification works. Outside the actual reservoir, however, a good deal of other engineering work was necessary in the construction of the intake channel from the river Thames, road diversions, bridge building, &c.

The intake has been formed on the banks of the river Thames just below and within sight of Penton Hook Lock. It is a handsomely designed structure carried out in concrete faced with grey Cornish granite, which in the position in which it is placed, does not disfigure the river more than would a granite bridge, and may be fairly described as dignified. It is illustrated in Figs. 10 and 11, page 682, and in our Supplement. It was formed inside a cofferdam of steel sheet piling, the piles of which were in two lengths joined together with fish-plates, the upper rows of bolts being replaced by wooden pegs after the piles had been driven. Arrangements were so made that the joints came at the level of the floor of the intake, and when the time came to remove the cofferdam, the lifting of the upper portions of the piles simply had the effect of shearing the wooden pegs without disturbing the lower portions of the piles, which were allowed to remain as driven so as to protect the foundations from damage by the flow of the river. The intake consists of three arched openings each 18ft. wide with two piers each 4ft. wide separating them. In front of the three openings are three timber booms, 15in. by 15in., to prevent the ingress of large floating bodies, and, incidentally, to keep river craft from passing under the intake arches. The arches carry a towing path with a footway on each side of it, the bridge so formed being 28ft. 6in. wide between centres of parapets. An iron railing has been provided above the parapet of the bridge for the easy passage of towing ropes, though we believe that, in these days of tugs and self-propelled barges, practically no towing is done along the river bank at this point. On the landward side of the bridge, the intake channel is slightly curved in plan, and its floor, which is of concrete varying in thickness from 3ft. to 2ft. 6in., is stepped and sloped down from a level of + 33.0 O.D. to a level of + 25.5 O.D., or through a height of 7ft. 6in. It may be explained that the normal top water level in the river is at + 39.0 O.D., so that the depth of water above the floor of the channel is, when the river is at that level, 13ft. 6in.

Across the inner end of the channel is a vertical bar grating which is fixed immediately in front of three roller sluices with a clear width of 11ft. 6in. and a height of 6ft. arranged in three channels that lead to the bell-shaped mouths of three Venturi tubes. (See Supplement.) These tubes, the axes of which are arranged at level + 30.0 O.D., are 101ft. long and of the form shown in Fig. 12. The diameter at each end inside the bell mouths is 9.0ft. and the diameter at the throats 4ft. 10in. The bodies of the tubes are formed of mass concrete, while the throat piece is of cast iron, with gun-metal liners at the most constricted part, and at the beginning of that portion of the tube which is used for measuring the flow of water. At ground level over the throats, is a red brick building with Portland stone dressings, containing the recording mechanisms and accessories, which were supplied by George Kent. Ltd., of Luton. All the water abstracted from the river has to pass through these tubes, and the quantity is measured and automatically recorded. Immediately in front of the discharge mouth of each tube is a roller sluice gate with a clear width of 11ft. 6in. and 9ft. high, all the sluices delivering into a single forebay from which starts the intake channel leading to the pumping station. These sluices, as well as those between the river and the inlet ends of the Venturi tubes, were made by Ransomes and Rapier, Ltd., of Ipswich.

Over the beginning of the intake channel is a bridge which carries the road running from Staines to Laleham. In style this bridge is uniform with that carrying the towing path, and the remainder of the intake works. It has two spans each 12ft. wide and having a rise of 4ft. 6in., and is of concrete faced with granite. It is a handsome structure, and the view of it across the forebay from the platform above the inner sluice gates is very striking. (See Supplement.) The inlet channel, which is approximately three-quarters of a mile in length, is straight in the first and last portions of its course, with a double curve approximately in the centre of its length. It is of the cross-section—shown in Fig. 3—the width at the bottom being 15ft. and the sides sloping up with a batter of 1½ to 1 to the level of + 40.0 O.D. The bottom is paved with concrete slabs 6in. thick at its lower end, and with

FIG. 6—INTERIOR OF SUCTION BASIN, SHOWING MOUTHS OF SUCTION CONDUITS

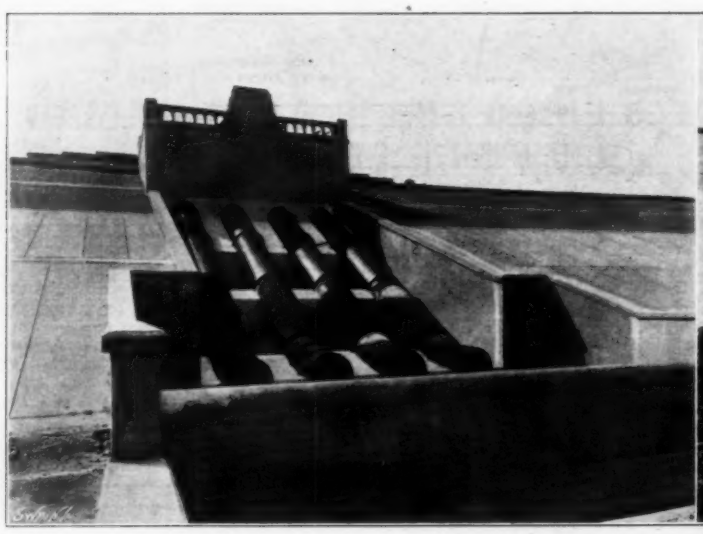


FIG 7—DELIVERY PIPES AND WEIR OF DISCHARGE BASIN

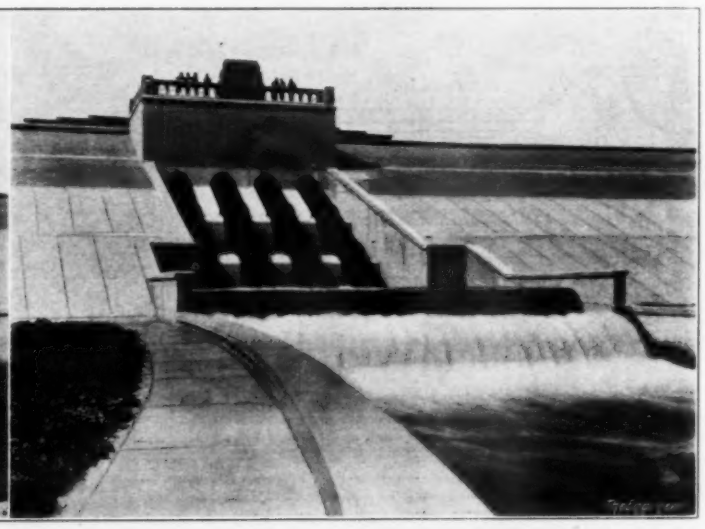


FIG. 8—WATER FLOWING OVER WEIR OF DISCHARGE BASIN

pre-cast concrete pitching blocks 8in. deep at its upper end, while the slopes are pitched with concrete blocks. The banks on each side are levelled at + 40.0 O.D., for a varying width, depending on the depth of the channels and then sloped up on each side to level + 46.0 O.D., or to the existing surface where that is at a higher level, so as to form berms to prevent the water from overflowing when the river is in flood. The berms are soiled and sown with grass seeds throughout.

In addition to the bridge already mentioned, there are two other bridges across the channel before the pumping station is reached, one of them—that carrying the Laleham–Ashford road—being similar in design and construction to the Laleham–Staines road bridge, and the other, an accommodation bridge, being a single-arch reinforced concrete structure. Views of both these bridges are given in the Supplement.

Before the work of excavating for either of the intake works or the channel was begun, it was known that a good deal of water would be met with. What practically amounts to an underground river of considerable volume was known to flow in a direction approximately parallel with the valley line, so as to cut right across the works and channel. By arranging pumping plants on the upstream side of the excavations, all trouble from water was surmounted, though at times it was necessary to pump considerable quantities. This underground water is, we understand, of great purity, having been filtered on its course through continuous beds of ballast.

Arrived at the site of the pumping station, the

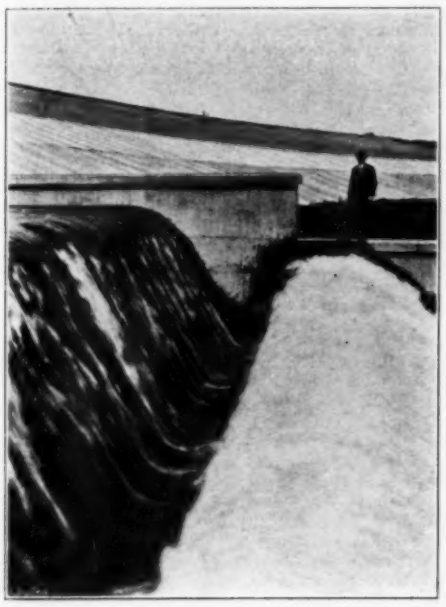


FIG. 9—WAVE BELOW WEIR OF DISCHARGE BASIN

channel widens out and passes under a parapet below which is fixed a straining screen. Unlike the parapets of the bridges hitherto mentioned, that at the end of the channel is made of grey Forest of Dean stone, which is almost severe in appearance, and is given a smooth surface that is in considerable contrast with the rough-hewn surfaces of the granite-faced bridges. The gradient of the intake channel throughout its length is 1 in 2000. The arrangement of the suction basin and of the suction conduits and discharge pipes at the pumping station are shown in Fig. 4. The suction basin is of concrete, and measures 95ft. long by 20ft. wide, the surface of its floor standing at level + 24.25 O.D. It is covered in with a reinforced concrete roof, with earth filling on top of it. As indicated by the broken lines, four suction conduits formed in concrete are taken to points under the pump-house floor, where they terminate by a junction with tapered steel bends which are attached to the suctions of the pumps. The diameters of these conduits are reduced in stages from 7ft. 6in. to 5ft. in diameter, the diameter of the pump suctions being 4ft. 6in.

Leaving till later our reference to the pumping station, we may here say that the discharge from the four pumps is in each case into a 48in. bend, which is connected through a 48in. sluice valve and taper piece to a 60in. diameter steel delivery main. Each delivery main, before it is taken up over the reservoir embankment, is furnished with a 60in. reflux valve. The four mains are then led side by side under the channel which has been constructed at the foot of the reservoir embankment for the diverted river Ash, immediately after which they are taken upward at a slope of 2½ to 1 to above the top of the core wall of the embankment, the centre line of which is 321ft. distant from the centre line of the discharge pipe of the most distant of the pumps in the pumping station. We shall explain in a later article the way in which the pipes are led over the embankment, merely stating at the moment that they are carried in saddles formed on an arched concrete structure built on both sides of the clay puddle wall. Surmounting the inlet mains on the reservoir side is an embayment with parapets of Forest of Dean stone. Access to the embayment is obtained by means of a flight of concrete steps. From the top of the embankment the four pipes are led down into the reservoir at a slope of 2 to 1, and their ends are kept completely immersed, even should the water in the reservoir be drawn off to a very low level, because of a concrete weir wall, 50ft. wide, constructed across the discharge basin, and of such a height as to raise the water level in the basin high enough to cover the mouths of the pipes. It will be realised that this arrangement is entirely different from that employed at the large reservoir at Chingford, where the discharge from the Humphrey pumps is allowed to descend in a stepped cascade from the top of the reservoir embankment. The advantage, however, of having the discharges drowned will be at once realised, since, because of syphonic action, the static head against which the water has to be pumped at any time is practically only that due to the difference in level between the water in the suction chamber and in the reservoir, though actually, of course, the water passes right over the top of the embankment. The weir, it may be remarked, has other uses, for, by reason of the reverse curvature given to its base on the reservoir side, it breaks up the discharge from the pipes, throwing it upwards as seen in Fig. 9, and causes a steadying of the flow over the tail bay through which it passes into the reservoir.

From the highest points in the four delivery pipes at the top of the embankment pipes are led back to exhausters in the engine-house, so that, when there has been no pumping for some little time, any air which may have accumulated in the pipes may be removed before the pumps are put to work again. Valves are also provided at this point to permit of the breaking of the syphon action should this be necessary at any time to prevent a back syphonage from the reservoir.

The International Railway Congress.

No. III.*

HIGH-SPEED ELECTRIC LOCOMOTIVES.

THE reporter for America under this heading, which is Subject V., is Mr. J. T. Wallis, the Chief of Motive Power, Pennsylvania system, who opens by remarking that his contribution was intended to supplement the reports presented by Mr. George Gibbs to the Berne and Rome Congresses of 1910 and 1922 respectively.

There are few railways in America operating what may be called high-speed electric locomotives, *i.e.*, those of 45 miles per hour or higher. There are others, but their speed is only 45 miles per hour or less, and they usually handle trains for a short distance, mostly through tunnels. None of the latter are considered in the report as they only operate freight trains.

In the development of the electric locomotive the problem that has probably received more serious study than any other is the application and position of the motor and the mechanical transmission between the armature shaft and the driving wheels. Many different solutions have been offered. It is not surprising, therefore, that the three electrified railways entering New York City have radically different types of drive. It is especially notable that the first locomotives put into operation on the three roads into New York were all equipped with gearless motors, indicating a serious distrust of, and dislike of, the gears of that time, which were not comparable with the present high grade product. The locomotives of the New York Central have the most direct connection between motor and axle, the armature being built solidly on to the driving axle. The use of a bi-polar motor permits the armature to move freely in a vertical direction between flattened pole faces, so that the entire motor, except the armature and brush holders, can be carried by and be a part of the locomotive framing. That motor has the advantage of a rigid connection between the armature and axle, and completely eliminates motor bearings. That it has not been adopted more generally is due, in part, to its restriction to direct-current, and probably also to the low efficiency and small capacity in slow service.

The original locomotive of the New York, New Haven and Hartford Railroad had two bogie trucks and spring-supported gearless motors. It was found necessary to modify the design in order to improve the tracking characteristics. An idle axle was added at the outer end of each truck, in the same rigid wheel base as the drivers, which increased the total wheel base to 30ft. 9in. The output of the motors was low on account of the low armature speed, for which reason the type of gearless motor used on the original locomotives has not been perpetuated. Because of their restricted capacity it was necessary to couple two and sometimes three locomotives together for heavier trains. To decrease such double-heading two experimental locomotives of greater capacity were tried, but they were not satisfactory. A third, of the 2–4 + 4–2 type, with a wheel base of 38ft. 6in., was later adopted. It was equipped with four motors mounted above corresponding axles, and geared to quills concentric with the axles and with large clearance. The drive transmits the forces from the quill to the driver by means of long helical springs, with one end of each spring clamped to a projection on the quill, or gear centre, and the other end to the wheel, thereby providing for ample vertical play between quill and axle. The other locomotive of the last-named type was built with four motors, after which two motors per axle, known as twin motors, were used. The wheel base in that case was 40ft. 6in. The change was made because it effected a substantial saving in weight and cost of both motor and control equipment. A further reason was that the parts of the twin motors were, with the exception of the frames, interchangeable with the motors of the multiple-unit cars in service on the New Haven line. That type of motor and drive equipment is now the New Haven standard for both passenger and freight service, the only difference being in the gear ratio. There are 40 such locomotives. The increase in the weight of trains led to five 2–6–2 + 2–6–2 locomotives being built in 1919, with a wheel base of 59ft. 6in., and twelve more in 1923–24.

The New Haven type of quill spring drive was applied on the Chicago, Milwaukee and St. Paul locomotives of the 4–6–2 + 2–6–4 type. It suffered severely from spring breakage on account of a combination of circumstances. Seven springs per wheel were used instead of six, but the axle loading is 34 per cent. heavier than the minimum of the 2–4 + 4–2 and 61 per cent. heavier than that of the 2–6–2 + 2–6–2 of the New Haven Railroad. The wheel base is much longer, more axles are grouped in one equalisation, and the track has numerous sharp curves. Hence there was much greater and more frequent decentralisation between quills and axles. Based on the experience with these locomotives the drive was replaced by another employing the same quills but having shorter springs enclosed in grease-filled cups, clamped to projections on the gear centres. They drive through corresponding case-hardened wearing plates on the wheels. These springs are not affected by lateral motion of the wheels and, in driving, are subjected only to compression. The original springs, on the other hand, clamped at both ends, were subject to compression, elongation and transverse flexure, but had no wearing parts.

The design adopted by the Pennsylvania Railroad has a 2–4 + 4–2 wheel arrangement. The motors are placed above the frames and the drive to the axle is taken through a jack shaft and rods. The wheel base is 55ft. 11in. By mounting the single large motor above the frame in each half of the locomotive, all the power equipment is brought well above the running gear, and the height of the centre of gravity of the locomotive approaches that of a steam locomotive. Tests demonstrated that it is free from all tendency to objectionable lateral oscillations, and it is regarded as an exceptionally good tracking locomotive.

The analysis of these high-speed electric locomotive designs seems to disclose a distinct tendency to adopt the principle followed for steam locomotives, which is to place the driving wheels in groups of two or more and provide guiding effect therefor by a leading truck composed of either driving or truck wheels or both. The leading truck may be a semi-unit, as in articulated steam locomotives of the Mallett type, where the superstructure is attached to the frame of the rear semi-unit and overhangs the forward semi-unit, with provision for restrained lateral motion relative thereto. The simplest form of guiding truck is the radial pony truck with radius bar of such length that the centre line of the axle remains practically in line with the radius of the curve.

The indications are that locomotives using the ordinary type of quill drive should not have more than three axles per truck, and when the load per wheel is relatively large, they should have only two axles per truck. The leading axle is usually provided with means for side motion when the guiding wheel comes into contact with the outer rail on curves. That side motion is resisted in various ways, and all late designs provide for an initial resistance. The inquiries made by the reporter show a tendency towards greater application of the principles followed in steam locomotive design and towards a greater co-operation between the electrical and mechanical engineers. That, he observes, is a very hopeful indication.

The reporter for all countries except America is Mr. Weiss, the Chief Locomotive and Rolling Stock Engineer of the Swiss Federal Railways. He remarks that at the end of 1923 there were about 143 electric express locomotives distributed in the various countries for which he reports. They were:—England, 20; France, 1; Italy, 45; Switzerland, 35; Sweden, 4; Germany, about 38. The greater number of the companies using electric locomotives have had them constructed with carrying as well as driving wheels. Locomotives for express trains are characterised by the arrangement of the driving motors, depending on the kind of current employed. With three-phase current, two motors are generally used. They are coupled in cascade, and (by pole changing) four different running speeds may be obtained. In the case of single-phase current, all arrangements are possible, even the use of a single traction motor, developing up to 3000 horse-power for one hour, as fitted on the 4–8–2 and 4–6–4 locomotives of the German State Railways, or with twin motors for each driving axle, i.e., six motors for a six driving-wheel locomotive. The continuous-current locomotives are generally fitted with one motor per axle, but there are some

* No. II. appeared June 12th.

instances of twin motors, and on the trial locomotive of the Paris–Lyons–Mediterranean Railway there is an arrangement of a motor at a height above the axles and driving through rocking levers.

The methods of driving may be divided into two main systems—driving by means of connecting-rods and driving independently. Both are used on locomotives for hauling express trains. Driving by means of connecting-rods enables the traction motors to be placed high, which appreciably improves running. The commutators, moreover, are more easily accessible. The Italian State Railways only use the connecting-rod drive in the case of their three-phase and direct-current locomotives, and the same practice is adopted by the Swedish State Railways for their single-phase locomotives. The difficulties found by some administrations in driving through connecting-rods—producing vibration that causes damage to the mechanism—may be avoided by inserting a suitable elastic connection and by accurate workmanship in the whole mechanism, as well as by careful maintenance of the bearings of the axles and of the connecting-rods.

Among the connecting-rod drives, the Ganz system, which has been adopted on the Paris–Orleans 4–8–4 locomotive, should be mentioned. One of these locomotives is fitted with an isostatic system—without connection between the crank arms of the motors—developed from the Brown, Boveri Company's system, which has been through its trials and which has double connecting-rods and motors with elastic transmission. A trial locomotive on the P.L.M. of the 4–4–2 + 2–4–4 type is fitted with an Auvert connecting-rod, as described in the August, 1924, issue of the *Revue Générale des Chemins de Fer*. By means of it, it is hoped to obtain the same conditions of elasticity and flexibility as in steam locomotives. There should also be noticed the driving system of the 4–4–2 and 4–6–4 locomotives of the German State Railways. A large motor drives from the front and from the rear by means of two connecting-rods, inclined at 45 deg., on each side, to two intermediate shafts. The locomotives, of which the most recent are fitted with motors having elastic transmission gear, give, it appears, very smooth running.

The independent drive, which is most largely used in the countries under consideration, as exampled on the Metropolitan of London and the Paris–Orleans railways, does not appear to the reporter suitable for express trains, because the centre of gravity of the traction motors is placed very low. Furthermore, particularly when the axle-borne motor drive arrangement is adopted, the variation of loading of the wheels is appreciable. With that system, the construction of the chassis is very simple; the side frames are outside the wheels and the axle-boxes and suspension springs are easily accessible. The gearless system is only to be found in Europe in one trial locomotive built for the Paris–Orleans line. Notwithstanding the unfavourable position of the centre of gravity, this locomotive, which is fitted with bogies at each end, is intended for use at the highest speeds. In all other independent driving systems the motor is rigidly fixed to the chassis, consequently it is not subject to the shocks to which the axle motor is subjected.

The reporter has received but little information on the experiments that have been made with electric locomotives on through trains, even from those administrations that have had them in service for a long time. According to the particulars supplied, the mean distance run by a locomotive of each type in one month varies from 1100 to over 6200 miles, and the mean annual distance—including stand-by and shed time for minor repairs—from 14,000 to 70,800 miles. On the Lucerne–Chiasso line the mileage per month is 8700. For the sake of comparison, the reporter observes that on the Swiss Federal Railways the steam locomotives for through trains run under the most favourable conditions from 6200 to 7450 miles per month.

It is noted that the Italian State Railways are about to try the system of transmission by jointed connecting-rods and coupling-rods, and that the Swiss Federal Railways find that the 2–6–2 type locomotives used on through trains do not take the curves quite satisfactorily. That defect arises, on the one hand, from the centre of gravity being placed too low, as well as the outside arrangement of the axle-boxes of the driving axles, and, on the other hand, because the distance between the pivot and the axle of the Bissel truck is too short, thus causing the carrying wheels to bear hard against the inner rail on curves. That defect has been, to some extent, corrected by means of an auxiliary arrangement for restoring the bogie to normal. Those engines with the Westinghouse drive, now under construction, will be fitted with radial axle-boxes, in place of the Bissel truck. One is fitted with a bogie at one of its ends, which arrangement, among other advantages, does not necessitate the transformer being placed above the motors, so that greater facility of access to the latter is secured.

The report by Mr. Weiss is accompanied by twenty-six diagrams in outline of various electric locomotives, together with an appendix giving a summary of the replies to his questions from the Metropolitan Railway, London, three French railways, the Italian, Swedish and Swiss State and the Austrian Federal railways.

Engine Sheds.

The question under Subject VI. is "Arrangement of Locomotive Sheds. Installations for (*a*) Inspecting Engines, (*b*) Washing out Boilers and Blowing Through the Tubes, (*c*) Lighting-up of Engines and Getting Rid of the Smoke, and (*d*) Loading Fuel on the Engines. Mixing Fuel. Disposal of Ashes. The Recovery of Coal and Coke from the Residues of Combustion." Report No. 1 for the British Empire is by Mr. R. E. L. Maunsell, Chief Mechanical Engineer, Southern Railway.

There is a difference of opinion in England as to the most suitable type of engine shed. The London, Midland and Scottish and the Great Western prefer the turntable type; the London and North-Eastern and the Southern prefer sheds with parallel roads. In a turntable shed the maximum number of engine pits depends to some extent on the diameter of the turntable. They average about twenty-two pits for a 50ft. table and twenty-six for a 65ft., including incoming and outgoing roads. In order to accommodate a larger number of engines, two or more turntables must be provided. The minimum number of engines stationed at a turntable type of shed is given by the Great Western Railway as thirty. For a lesser number it is the practice on that railway to adopt a straight shed.

The general opinion is that incandescent electric light is the most satisfactory illuminant for running sheds, yards and coaling points, and, on account of the ease with which electric current can be conveyed to any point for inspection or other purposes, that form of lighting is used wherever possible. In some cases high-pressure gas is preferred for general illuminating purposes, notably at Derby on the London, Midland and Scottish Railway.

Although doors are fitted to the running sheds of most British railways, the general opinion is that they are not necessary, except in very exposed places or where a staff is not constantly on duty. Engine pits, whether inside or outside the sheds, are usually faced and paved with hard bricks. Concrete, without brick facing, is, however, generally used overseas, except in India. The depth of the pits for standard-gauge lines is usually 3ft., for broad-gauge lines 2ft. 6in., and for narrow-gauge lines 3ft. 6in.

On British and Irish railways barracks are provided for men required to take rest away from home, where lodgings are not easily obtainable. The sleeping accommodation usually consists of single or double cubicles, fitted with fully furnished beds. A mess room and lavatories are also provided, and in some cases reading and recreation rooms. Lockers are allotted at sheds for enginemen to store their clothing or personal effects in, while on or off duty. Apart from these provisions for men who have to rest away from home, it is the general practice to have a mess room, with cooking facilities and utensils, for the regular staff employed at running sheds, and at some recently established depôts, lavatories, with hot and cold water supply and fitted with shower baths, have been provided. The comfort and recreation of the staff are points which receive special consideration.

The practice of washing out boilers with hot water has been largely adopted and is generally preferred. The system most generally in use is that in which a portable injector is fixed directly to any hydrant, a supply of steam being taken from a stationary boiler or an adjacent locomotive. In some of the larger depôts special plants are provided for hot water washing and water changing. A test of the "Economic" hot water installation on the London, Midland and Scottish Railway gave the following results:—Blowing down, 18 min.; taking out plugs, 20 min.; washing out, 32 min., replacing plugs, 15 min.; filling up, 8 min.; total, 1 h. 33 min. Mechanical or other methods for removing scale from boilers have been but little adopted. In a few cases various chemical compounds are regularly used or are under trial.

In the larger depôts on British railways, where extensive repairs are carried out, overhead electric cranes are most generally employed. At smaller depôts, where only running repairs and examinations are attended to, wheel drops are generally used or preferred, except on the Great Western system, where movable hoists, operated by hand or power, are employed.

After giving two tables—(1) the methods of cleaning tubes and superheater elements, and (2) the methods of raising steam adopted by the twenty-four administrations which have replied—the report deals with the question of coaling engines. With the exception of the Great Western, British railway companies are adopting coaling plants at their larger depôts. Where mechanical plants do not exist, the methods of coaling engines are various, but the high-level stage is most commonly used, and that method is extensively employed by the Great Western Railway. The replies received by the reporter do not indicate any novel method of removing fire refuse from engines. At Old Oak Common, Great Western Railway, smoke-boxes are emptied by means of a steam ejector connected with a pipe, one end of which is buried in the ashes, with the other end discharging into a wagon on an adjoining road. The London, Midland and Scottish Railway uses a method in which the ashes are raked from the engine into a hopper in the engine pit. They are discharged thence into a trolley skip, which, when full, is drawn up an inclined plane and the contents tipped into a wagon on an adjoining road.

Mr. Maunsell's report is accompanied by plans of typical engine sheds, *e.g.*, Old Oak Common and Feltham, and by drawings of coaling plants, engine pits, ash-handling plants, &c.

The second report on locomotive sheds relates to continental practice, and is by M. J. Jacometti, of the Italian State Railways. The third is by Mr. R. W. Bell, the General Superintendent of Motive Power, Illinois Central Railway, who says that arriving engines should pass to the coaling station for coal, where provision is also made for sanding at the same time. They are then moved to the cinder pits for cleaning fires and ashpans, and from there to the turntable and into the engine-house. Outbound engines, after leaving the turntable, pass the enginemen's tool equipment building, where they receive the tool kits, oil cans, pick, shovel and supplies, which have, previously, been removed from the engine when on the inbound track, and thence to the water column, coaling station and outbound storage space. All engine movements, from arrival to departure, are made by "hostlers," the enginemen leaving the engines on arrival and receiving them, fully equipped and prepared for service, on departure.

Drop pits or drop tables are recognised as essential in all round-houses, in order to enable all necessary work on wheels and journal bearings to be performed. Round-houses should have paved floors, be well heated and ventilated, and designed to obtain a maximum amount of natural light. As a measure towards reducing the time required in handling an engine at the terminal, and also to effect a saving in fuel, water and boiler repairs, a hot water boiler washing and refilling system should be installed in conjunction with the round-house. The wood block floor has gained in general favour in late years, on account of the ease on the feet of the workmen, the low cost of maintenance, the smooth touching surface it affords, its ability to withstand shocks caused by heavy pieces falling upon it, and the less liability of damage to the pieces themselves. Concrete and brick floors, though presenting good trucking surface, have the disadvantage of being cold and hard on the feet of the workmen, of easily chipping and cracking, and of wearing unevenly.

The present-day practice in engine pit construction is to build them of concrete with side walls of sufficient thickness to give proper bearing for hydraulic jacks used in jacking up engines. In some cases the walls are built the full thickness the entire length of the pit, while in other cases the increased thickness for jacking purposes extends only a distance of from 10ft. to 12ft. in length at each end of the pit. If there be considerable difference in the size of power handled, it is advisable to maintain the full thickness required for jacking throughout the entire length of the pit. The floor of the engine pit should be crowned from centre to sides, and have a gentle slope from the front to the rear.

At practically all termini of importance artificial lighting is obtained by means of electricity, and for the general inspection of the outside of engines in the round-house the general house illumination, augmented by the use of extension cord lights and hand flash lights, is sufficient. For the inspection of engines at inspection pits situated outside, a good arrangement consists of five 200 watts lamps, spaced 12ft. apart on each side of the pit, and placed about 15ft. high, with shallow dome reflectors, and two 50 watts flood lights, one at each end of the pit under the engine. For repairs to the engine there are used extension cord lights, flash lights and oil torches. The latest method employed is to light almost entirely by flood lights placed on the coaling station, round-house roof, water tanks or steel columns. Such lights should be placed so as to obtain light from two, or opposite, directions, in order that clouds of steam or smoke shall not shut off the illumination from any portion of the yard.

The remainder of Mr. Bell's report deals with American practice as to inspecting engines, washing boilers and blowing through tubes, lighting up engines and getting rid of the smoke, loading fuel on engines and disposing of cinders, storage and supply of sand, water supply, cleaning engines and turning engines.

Shunting Yards.

Subject III. has the brief title, "Shunting and Marshalling Yards for Goods Trains: Lay-out and Organisation." There are four reports, of which the first relates to all countries except America, Belgium, France and the British Empire, and is by M. W. Simon-Thomas, of the Dutch Railways.

The second report refers to America, and is by Mr. Samuel T. Wagner, the Chief Engineer of the Philadelphia and Reading Railway. It contains, in an appendix, information as to the practice on eighteen railways, and is accompanied by diagrams of nine typical yards. The reporter's conclusions are:—(1) Shunting yards, *i.e.*, where yards are on the flat and all shunting is done by engines, are the most common and are used where a more elaborate lay-out is impossible, and generally where the amount of business is relatively small. Under these conditions they are warranted and advisable. (2) Poling yards, where the classifications are made by a poling engine, are much more economical than the plain shunting

yard. They require a much more extensive lay-out, but are warranted where there is sufficient business to justify the cost of their construction. (3) Hump yards, where the cars are pushed over a summit into the classification yards, are chiefly used where a large volume of business is handled, since a greater number of classifications can be made in less time and at less cost than through almost any other form of yard. (4) Gravity yards, where the classifications are made by gravity alone, are ideal, as no other force than gravity is required in the classification. They are very economical, but are rare, as it is seldom that ground can be found with topographical features that will allow such a yard to be built without extraordinary expense.

For the British Empire the reporter is Mr. R. H. Nicholls, the Superintendent of the Line, Great Western Railway, who says that, as yet, there are on British railways few shunting yards constructed on gravitation principles. Most are of the flat type, constructed when railways were first made, and enlarged from time to time. When the enlargement limit has been reached, other yards have been made, often in close proximity, to serve as auxiliaries. The majority have dead-end sidings, but there are some double-ended yards with shunting spurs at either end. The tendency has been to patch rather than reconstruct, and the disadvantages are revealed in working costs. It is necessary to remember that the working efficiency of a shunting yard is more correctly measured by the wagons that can be passed through it in a given time than by the number which the sidings will hold.

Yards should be laid out to enable wagons to move only in one direction wherever that can be done. Reverse movements cause extra mileage, extra engine hours, greater wear and tear, and interference with yard movements. The best position is in the centre of two main running tracks, as seen in the new Harbanspura yard, Lahore. But that arrangement has the defect that future expansion is more limited. The next best is to have the up and down yards on the same side of the line, as at Feltham, on the Southern Railway. While the latter arrangement is open to the objection of compelling freight trains to cross a running line in the opposite direction, there are compensating advantages. Transfer from one yard to another can be more quickly performed; shunting, necessitating another engine when yards are on two sides, can sometimes be performed by one; supervision can be more easily exercised and staff economies effected; the use of sidings can be changed with variations in the flow of traffic; engines of incoming trains can more quickly reach the point from which outgoing trains start.

In discussing gravitational shunting by means of a "hump," the reporter compares the rate of movement of oil-lubricated wagons with those lubricated by grease. Tests made show that if a grease-box wagon is pushed over a 5ft. hump, *i.e.*, the top of the hump is 5ft. higher than the level of the sidings whither the wagon has to go, and is followed by an oil-box wagon, the latter will overtake the former within 300ft. or 400ft. from the bottom of the hump.

Investigations made by the Great Western gave the conclusion that within a distance of 525ft. from the hump summit to the extreme clearance point, eighteen sidings could be worked from one hump, if 8 chains curves were adhered to; 7 chains curves would allow for twenty-two sidings. The latter sharper curvature was, however, an objection. It is desirable that sidings inside clearance points should be straight for running and sighting purposes. Trains composed of sixty to seventy wagons, requiring 50 to 60 cuts, can be sorted within 15 min., as compared with 45 min. under flat shunting.

A very effective means of bringing wagons to a stand is the shoe type of portable skid which, placed on the rail, in advance of an approaching wagon, brings it to a state of rest in about its own length. The backward movement of the wagon, after its running has been arrested, throws it clear of the shoe and enables the latter to be removed.

Among the shunting yards of which diagrams are given are:—Harbanspura, Feltham, Toton, Wath, Edge Hill, Rogerstone (proposed), Llandilo Junction, and Bristol East depôt.

Traffic Control.

There are three reports on Subject VII., which relates to what is called train dispatching in America, and traffic, or train, control in this country. Of these reports the most interesting is probably that for the British Empire by Mr. J. H. Follows, the Chief General Superintendent of the London, Midland and Scottish Railway. Mr. Follows remarks that control embraces maintenance of punctual train working, according to the time-table. Arranging special trains for cattle, perishables, &c., and also for general traffic when booked services do not fully meet traffic requirements. Manipulation of engine power and traffic to best advantage. Loading of trains to maximum capacity. Diversions and cancellation of trains in case of accident or blockage of lines. The close watching of the volumes of traffic so as to obtain full trains to the fullest possible point, and the consequent avoidance of staging. Regulation of traffic to terminals. Suitable stowage of traffic that cannot be dealt with concurrently. Some systems also cover: Distribution of rolling stock. Regulation of extensive and exceptional traffic, *e.g.*, coal for shipment. Relief of enginemen and guards to prevent excessive hours. Rostering of trainmen. Compilation of time-tables and diagrams. Control may be exercised from one central office or by divisions through a divisional chief office responsible to the central office. The former method lends itself satisfactorily to separate passenger train control, especially in Great Britain, where the passenger services are so highly developed and the distances traversed are so short in comparison with most of the Colonial and foreign railways, and it is particularly advantageous in regard to loading and pilotage.

The provision of suitable control office accommodation has not received on some railways the attention which that important matter deserves. The relegation of control staff to any spare room that happens to be vacant is, as a general principle, to be condemned. External noise should be borne in mind when selecting control offices, and they should be light, airy and well ventilated, particularly bearing in mind that they are usually occupied throughout the twenty-four hours.

Control is exercised by telephonic communication. There is a tendency on some administrations to overburden their telephone circuits with intermediate points which frequently results in delay in obtaining communication. It is very important in controlling traffic that signalmen and others should not have to waste time in transmitting information or in asking for instructions. Such delays are irritating to the working staff and have a tendency to alienate their sympathy with, and to diminish their interest in, the functions of control. It may here be remarked that it is a mistake so to limit the responsibilities of signalmen and other staff on the line as to deprive them of any sense of originality or initiative.

For control trunk purposes on the London, Midland and Scottish Railway, independent circuits radiate from the central controlling authority, *i.e.*, the chief general superintendent's department at Derby, through the divisional controls to the district controls. From that it will be seen that the central and divisional authorities have trunk facilities for communication with all the offices for which they are responsible, and the divisional controls can readily intercommunicate. Telephonic intercommunication is available between all neighbouring district control offices which have affinity in regard to traffic working. Each district control office has adequate facilities for communication with stations, marshalling depôts, signal-boxes, locomotive and guards' depôts, &c.

Suburban Services.

Subject VIII. reads, "General organisation of suburban services, including tubes, on lines exclusively used as such or those not used for this purpose only—lay-out of stations and lines, signalling, rolling stock, time-tables, &c." Report No. 1 is for America and Great Britain, and is by Mr. E. C. Cox, the Chief Operating Superintendent of the Southern Railway, and Mr. Arthur R. Cooper, Chief Engineer of the Metropolitan District and London Electric Railways. The former displaced Sir Henry Blain, who was originally named as Mr. Cooper's colleague.

The terminus dealing with the largest number of trains in an hour—54 as against 49 for Liverpol-street and 43 for Waterloo—is the central station, Sydney. That station is to be reconstructed, certain lines being continued through it into the city in the form of a loop with six additional stations, approximately five-eighths of a mile apart. The lay-out of the present station is somewhat unusual in having—like the Brighton Station at Victoria—a middle road between each pair of platform roads and connected to them at each end by crossovers. That arrangement enables the engine of an incoming train to be quickly released. Another form of loop is to be found at the Grand Central Station, New York, whereby arriving suburban trains after discharging their passengers, can pass to the departure platforms. Although that station only deals with 36 trains in the maximum hour, they are considerably heavier than the average, and the number of passengers dealt with during the rush period is higher than any other station reported—42,000 as compared with 39,600 at Liverpool-street and 35,000 at Broad-street, Philadelphia, and at Jersey City. Allusion is made to the derailers which take the place of safety points at Liverpool-street, and give an additional 10ft. clearance in the engine-siding for the driver to stop his engine, resulting in a reduction in time taken to clear the locomotive.

Mention is made of terminal capacity being increased by electric traction on account of the quick passage of the train over the throat. That is particularly the case with the multiple-unit system, which has the additional benefit of avoiding shunt movements inseparable from locomotive working. An interesting example of how the capacity of a terminus was increased by electrification is presented by Victoria Station, Manchester. There the station was worked to its full capacity under steam, with five trains per hour per platform track, and now nine trains per hour are being run on the electrified sections, the only alteration being the provision of an additional crossover.

Very full particulars are given of the types of rolling stock used in suburban services on the twenty-three administrations which have replied to the reporters' inquiries and of their operation power employed, scheduled speed, number of cars per train and average length of journey per passenger. The report closes with a very full description of the engineering and operating features of the London tube railways, and of some characteristics of the Metropolitan and Metropolitan District systems.

Institution of Electrical Engineers' Summer Meeting.

No. II.*

Apart from the unfortunate fact that with the time at disposal there was little opportunity to study anything very closely, the Institution of Electrical Engineers' Summer Meeting, which was favoured with glorious weather, proved a great success, but it is doubtful if many belonging to the happy party would care to take part in several of such excursions in close succession. While we have no desire whatever to find fault with the excellent work carried out by the organisers of this Summer Meeting, there is no doubt, in our opinion, that an endeavour was made to do far too much, with the result that the trip was not of very great value from an educational point of view. Parties were conducted through large and important works at a rate which made it next to impossible to do more than glance at things on view, and if by any chance any member took part in the outing with the idea of improving his knowledge of electrical engineering, it is just possible that he was a little disappointed. But this practice of trying to do in a few days what really ought to take considerably longer is not confined to the Institution of Electrical Engineers. Practically all engineering outings are run on these lines, which are really more in conformity with American notions than they are with British. How many took part in all the evening functions, in addition to the motor coach journeys, the tours through central stations and works, river trips, &c., we do not know. Possibly quite a few spent one or two evenings resting quietly in their hotels, whilst those who still had energy to spare after their hot and dusty excursions danced at the Magnet Club of the General Electric Company and elsewhere. Still, as this method of running summer meetings appears to meet with general approval, or, at any rate, is not opposed, it is not for us to complain, and we must congratulate Mr. W. Lawson, chairman of the South Midland Centre, and in fact all that were responsible for the arrangements, on the very excellent way in which the extensive programme was carried through. Great praise is due to those who organised the various luncheons, teas, dances, &c. The hospitality extended to the visitors must have exceeded all expectations, and will no doubt long be remembered by every member of the party.

Following the inspection of the Nechells power station—described in our last issue—the party proceeded to the works of the General Electric Company, where a very excellent luncheon was provided, and subsequently the works were viewed. So much has been written about the Witton factory and the work that is carried out there that it is scarcely necessary to say very much about it here. Witton, as most engineers are probably aware, is only one of the firm's manufacturing centres, other factories of the General Electric Company being the Fraser and Chalmers engineering works at Erith, the Osram lamp works at Hammersmith, the Peel Conner telephone works at Coventry, the Pirelli general cable works at Southampton, the instrument works at Salford, the Chamberlain and Hookham meter works at Birmingham, the art metal works and the cooking and heating works, also in Birmingham, and the glass works at Leamington and Wembley. It is, of course, well known that at the latter place the company also has very extensive research laboratories.

In Fig. 2 a view is given of part of the Witton works, which, together with the offices, occupy about 35 acres, the total area of the whole of the Witton estate being 120 acres. A description of the works will be found in The Engineer of February 10th, 1922. Years ago the General Electric Company confined itself mainly to the manufacture of small electrical goods, but in these days it manufactures practically everything that enters into electrical work. During their tour through the shops the members of the Institution of Electrical Engineers had a good opportunity of gauging the nature of the heavy engineering work which the firm undertakes. There were, for instance, parts for two 22,500-kilovolt-ampère turbo-generator sets for the Birmingham Corporation's Nechells station, where three similar sets built by the company are already installed. A 12,500-kilovolt-ampère set, designed for a speed of 3000 revolutions per minute, was in the course of construction for the Sunderland Corporation, which has also ordered another set of the same size. Other turbo-generator orders in hand include units of the same output for the Portsmouth, Poplar and Southampton corporations, and several machines of smaller capacity were also seen in the course of manufacture. All the machines mentioned are to be driven by Fraser and Chalmers turbines.

While it is doubtful, in our opinion, if many members of the party obtained in the short time at disposal a very adequate idea of the important nature

* No. I appeared June 12th.

of the work that was going on, there were certain machines, apart from the large turbo-alternators, that could scarcely escape notice. A very conspicuous machine, for instance, was a reversible rolling mill motor, with a maximum output of 18,000 horse-power, made to the order of Baldwin, Ltd., of Swansea. Some 1500 and 2000-kilowatt rotaries, a close by a dance in the banqueting hall of the Council House.

On Wednesday morning, June 10th, the first item on the programme was a visit to the works of the Austin Motor Company at Longbridge. A party of nearly 400 people inspected this interesting factory, and was welcomed by Sir Herbert Austin, the manag-

FIG. 2—PART OF THE GENERAL ELECTRIC COMPANY'S WORKS AT WITTON

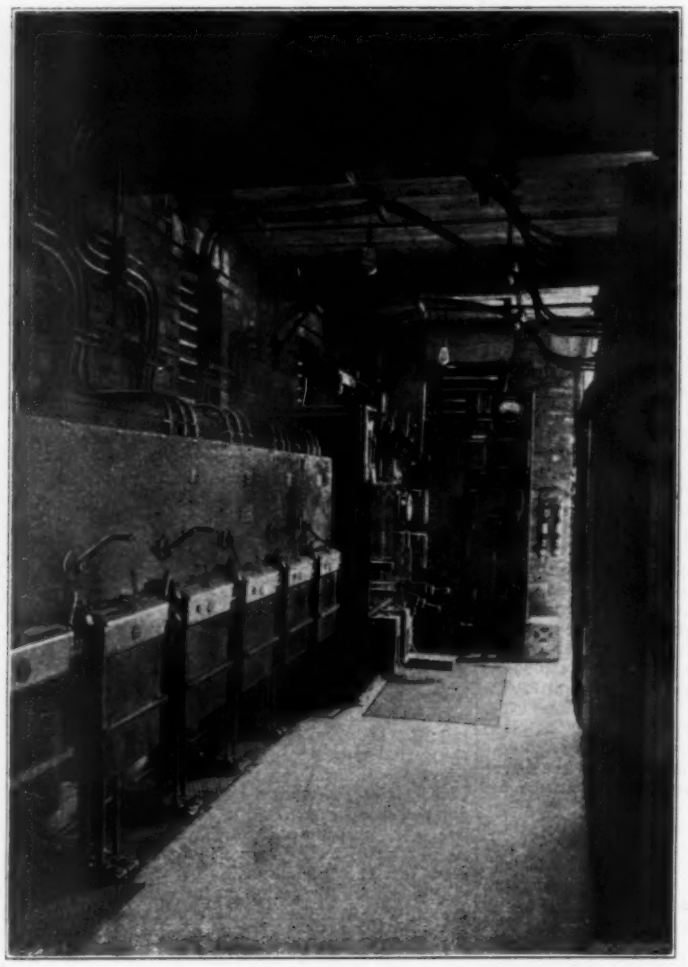
forming parts of large contracts for the Southern Railway and the South African Government Railways were all to be seen. Like various other electrical firms, the General Electric Company is now manufacturing motor converters, and among other machines of this type that came to our notice was a 2500-kilowatt set for the Charing Cross and West End Company.

ing director. When the company commenced operations in 1905 the works covered 2¼ acres, whereas they now extend over 62 acres, and, with the testing track and playing fields, the total site covers 220 acres. The present annual production is approximately 16,000 cars, and over 8000 people are engaged in their manufacture. The Longbridge traction rectifier sub-station, belonging to the City of Birmingham Electric Supply Department, was also visited by some of the members of the party on Wednesday morning. The sub-station contains mercury arc rectifiers—as described in THE ENGINEER of November 28th, 1924—with a total capacity of 825 kilowatts. These glass bulb rectifiers, made by the Hewittic Electric Company, of Hersham, Walton-on-Thames, convert three-phase 5000-volt 25-cycle current into direct-current, at a pressure of 550 volts. There are ten bulbs connected in parallel, each bulb giving 150 ampères at 550 volts, and two bulbs are supplied by a single transformer made by the B.T.H. Company. The high-tension switchgear was supplied by George Elfison, of Birmingham, and the direct-current automatic circuit breakers by the Igranic Electric Company. As two secondary windings on the transformer are arranged to give a six-phase supply to the two bulbs supplied, the ripple in the direct-current circuit has a periodicity of 150 cycles per second.

The extra high-tension switchgear is of the drop

FIG. 5—MERCURY ARC RECTIFIER SUB-STATION

tank type, which occupies a small amount of space. The incoming high-tension feeder to the station is controlled with a non-automatic switch, but the oil switch controlling the supply to each transformer has three overload trip coils with an adjustable time lag. Each rectifier unit has a low-tension alternating-current switch in the anode circuits, whilst an automatic reclose circuit breaker is connected to the positive pole. Moreover, each of the outgoing traction feeders is provided with an automatic re-close circuit breaker, which opens automatically on an overload or short circuit, and after a definite time interval



FIGS. 3 AND 4—VIEWS IN THE INTERIOR OF LONGBRIDGE MERCURY ARC RECTIFIER SUB-STATION

Afternoon tea having been served at Witton, the party was conveyed by motor coaches to Birmingham. At 8.30 p.m. there was a reception at the Council House, Birmingham, by the Right Hon. the Lord Mayor of Birmingham, Alderman P. Bower, and the Lady Mayoress, supported by Mr. W. Lawson, chairman of the South Midland Centre, and Mrs. Lawson; the activities of the day being brought to

re-closes again when the overload or short circuit conditions have been removed. The station is operated semi-automatically, a sufficient number of sets being left running on the bus-bars to meet the normal demand, whilst additional sets are put into service as required. The Igranic re-close circuit breakers on the low-tension side look after overloads and short circuits. An overload or failure on the high-tension

side shuts the sets down, but they are automatically brought into service again when the alternating-current supply is restored. An internal trouble on the rectifier or transformer opens the low-tension and high-tension oil switches, and the set is put out of commission until an attendant arrives and rectifies the defect. Each glass bulb has an automatic rocking arrangement for the purpose of exciting the bulb, and an auxiliary transformer is used to maintain a small auxiliary arc in the bulb independently of the external load. Each bulb is also provided with a fan for cooling purposes. Internal and external views of the sub-station are given in Figs. 3, 4 and 5.

Having inspected the Austin works and the mercury arc rectifier sub-station of the City of Birmingham Electric Supply Department, the party left Longbridge for Droitwich, *viâ* Catshill and Bromsgrove, and in passing through Catshill the members were afforded an opportunity of viewing a typical overhead distribution system of the Shropshire, Worcestershire and Staffordshire Electric Power Company. These overhead lines, which are for low-tension three-phase four-wire distribution with earth neutral, are of considerable interest, and might be employed with advantage in many other parts of the country. In Fig. 7 we give a sketch of the pole equipment, where A is a spun copper finial; B, a creosoted fir pole; C, a galvanised wrought iron bracket; D, Buller's porcelain insulators; E, a service bracket in use; and F, a service bracket in reserve. The principal features claimed for these low-tension pole equipments are accessibility, strength and rigidity, uniformity of sag on the long wires, the ease with which services can be provided, facilities for the duplication of conductors, neatness and standardisation, and the avoidance of crossing conductors of opposite polarity.

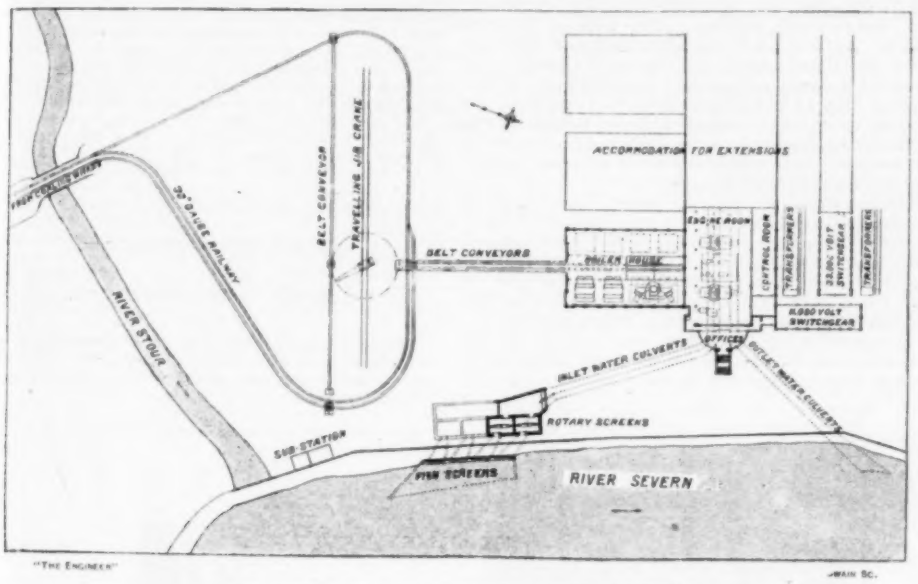


FIG. 6—PLAN OF THE STOURPORT POWER STATION

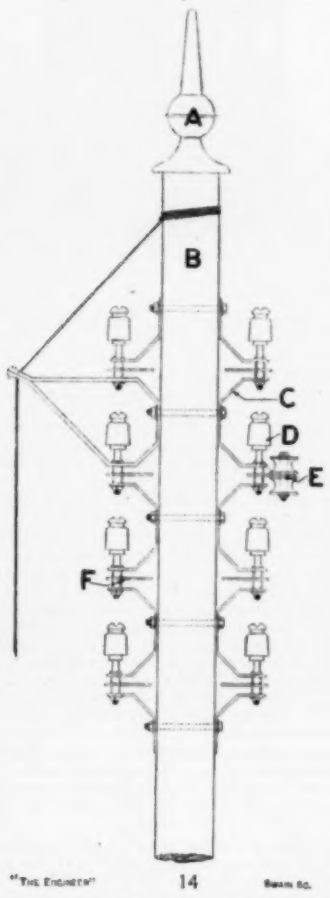


FIG. 7—POLE FOR DISTRIBUTION LINES

At Droitwich an excellent luncheon was provided by the power company, after which the members proceeded by road to Holt Fleet on the river Severn, and then by steamer to Stourport, where the company's new power station, now under construction, was inspected. For the erection of this station the Shropshire, Worcestershire and Staffordshire Electric Power Company acquired 32 acres of land on the eastern bank of the river Severn, immediately south of the confluence of the river Stour with the Severn. Other land was also acquired to afford connections with the large unloading docks of the Staffordshire and Worcestershire Canal Company and the Great Western Railway. The minimum amount of water available for condensing purposes is 240 million gallons per day whilst the site is also very favourably situated from the point of view of obtaining cheap and abundant supplies of fuel from various Midland coalfields *viâ* the canal railway and river. With the large amount of condensing water available the plant could easily be extended and made to develop 250,000 kilowatts without the use of cooling towers.

The general arrangement of the site, power station and coaling gear is given in Fig. 6, the portion in the course of erection being shown in full lines. Two 15,000-kilowatt turbo-alternators and two 750-kilowatt house sets, together with the auxiliary plant, are being installed in the first section of the turbine room, which is 136ft. long, 78ft. wide and 80ft. high, and is spanned by an electrically operated crane capable of lifting 100 tons on the main hoist and 25 tons on the auxiliary hoist. Overhead bunkers in the boiler-house, which is 141ft. long, 93ft. wide and 74ft. high, are capable of holding 100 tons of coal. Circulating water reaches the pumps by way of twin ferro-concrete culverts, each having an area of 62 square feet. The water from the river passes through fish screens and penstocks to screen chambers, containing rotary screens, 27ft. in diameter. From the screen chambers the water passes directly underneath the condensing plant, the pumps, which are on the basement floor level, being designed to give the necessary suction head. By means of a single ferro-concrete culvert, with an area of 59½ square feet, the discharge is carried to the river at the down-stream end of the site.

Four Stirling Tri-drum boilers, each designed for a normal evaporation of 60,000 lb. of water per hour and up to 100,000 lb. per hour in the case of emergency, constitute the initial boiler-house equipment, and to each of these boilers two Babcock and Wilcox forced draught compartment-type chain grate stokers, capable of consuming up to 6 tons of coal per hour, are fitted. Integral Stirling superheaters raise the temperature of the steam to 725 deg. Fah. the working pressure being 350 lb. per square inch. Babcock and Wilcox horizontal steel tube economisers are erected on a steel structure immediately above and integral with the boilers. Each boiler discharges the flue gases through a Sirocco dust catcher into a common steel stack, with the aid of induced draught fans, which are situated on a floor above the economisers. Forced draught fans are placed in a special fan room in the boiler-house, and, although each boiler has its own fan, arrangements are made for the fans to work through a common distributing duct if necessary. At present, however, the station is in a very incomplete state, and we do not propose to say more about it, except that current is to be generated at 5500 volts and at a periodicity of 25 cycles per second, the pressure being transformed up to 33,000 volts, at which voltage the switching operations will be carried out.

The main contractors for the steam-raising plant and mechanical stokers are Babcock and Wilcox, Ltd.; for the forced and induced draught fans, dust catchers and stacks, Davidson and Co., Ltd.; the coal-handling and stocking plant, the Mitchell Conveyor and Transporter Company, Ltd.; the turbo-alternators, condensing plant, auxiliary turbo-generators and condensing plant, the British Thomson-Houston Company, Ltd. (Cole, Marchent and Morley being the sub-contractors for the complete condensing plant, evaporating and de-aerating plant); for the switchgear, the British Thomson-Houston Company; the transformers, the Brush Electrical Engineering Company and the Metropolitan-Vickers Electrical Company; the turbine room crane, Stothert and Pitt, Ltd.; steam feed and engine-room pipes and valves, Stewarts and Lloyds, Ltd.; feed pumps, G. and J. Weir, Ltd.; foundations, J. and W. Stewart; building steelwork, Braithwaite and Co. (Engineers), Ltd.; and for the building, Mitchell Conveyor and Transporter Company, Ltd.

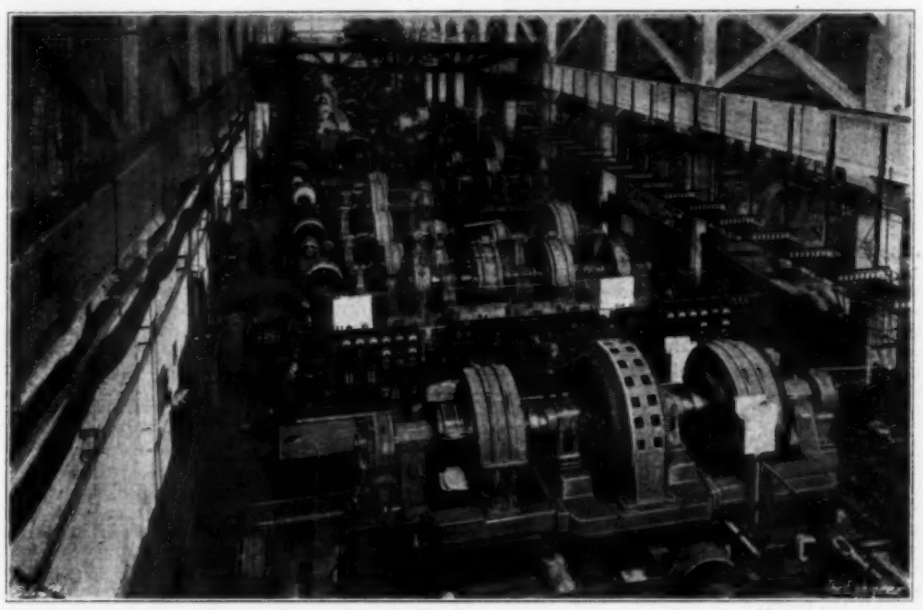


FIG. 8—PART OF THE BRITISH THOMSON-HOUSTON COMPANY'S WORKS AT RUGBY

Tea having been provided by the Shropshire, Worcestershire and Staffordshire Electric Power Company, in the grounds of the Arley Hotel, the party left Stourport for Birmingham, where at 8.30 p.m. there was a reception and dance at the University, Bournbrook, the party becoming the guests of the Council and Senate of the University. The guests were received in the drawing-office by the Vice-chancellor (Sir Gilbert Barling), Miss Barling and the Principal of the University. Various departments of the University in the main block of the building were open

for inspection and arrangements were made for small parties to ascend the tower.

On Thursday morning the members left Birmingham for Rugby, where they inspected the British Thomson-Houston Company's works. As in the case of the visit to the General Electric Company's factory, the time at disposal was altogether too short to enable those who toured the various shops to collect very much information or even to gain a clear insight into all that was going on, notwithstanding that the company's staff did everything in its power to make the visit a success. The buildings visited included the Mazda lamp factory, the control gear factory, the turbine, generator, rotary converter and motor generator departments, foundry, apprentice departments, &c. The tour also embraced an exhibition of finished products, not only of the Rugby works, but also of the Willesden, Birmingham and Coventry factories, so that the visitors had an opportunity of seeing practically everything electrical that is manufactured by the company. For the benefit of members of the party who, through fatigue or for other reasons, did not desire to inspect the shops, a lounge was provided, and as another alternative to the works tour, an exhibition of the company's industrial film was also given in the lecture room. Similar arrangements had been made at the General Electric Company's works, where the ladies were treated to demonstrations in the use of electric cooking appliances, &c.

The main Rugby works of the British Thomson-Houston Company now extend over 90 acres, and have a floor space amounting to 1,250,000 square feet, exclusive of the auxiliary factory devoted to the manufacture of electric light fittings for use with Mazda lamps, which are manufactured in the main Rugby works.

Probably the most impressive buildings associated with the Rugby factory are those devoted to various processes in the manufacture of large machines, such as the pattern shop, foundry, turbine machine shop and rotary converter shop. The foundry is a three-storey building, having a floor area of 43,000 square feet, the ground floor being devoted to heavy iron castings weighing up to 40 tons, whilst the other floors are used for smaller castings in iron and non-ferrous metals. The largest building belonging to the works is the turbine machine shop, which is 1000ft. long, with a frontage of about 270ft. facing the central avenue in the front of the foundry. The castings for turbine machinery are brought in from the foundry at the south end of the shop, where the heavy machining operations are performed. The completed machines are assembled and tested about the middle of the shop, and the dismantled machines are loaded on to railway trucks in the dispatch section at the north end of the shop. Smaller operations, such as turbine blading and rotor winding, are performed on the side galleries of the main bay; the galleries being equipped with landings for transferring material to and from the main bay and with travelling and jib cranes for transporting material. Five overhead travelling cranes span the main bay. A view of part of the British Thomson-Houston Company's works is given in Fig. 8, the machines to be seen in the foreground being large motor generators designed for a pressure of 3000 volts on the direct current side.

The tour of the works over, the parties returned to a large marquee leading from the reception marquee where they were entertained at luncheon, after which the visitors left Rugby for Warwick, where the castle and grounds were inspected, and, by permission of Lord Leigh, the route from Rugby to Warwick was through the Deer Park and past Stoneleigh Abbey. A civic reception and address of welcome was given by the Mayor of Warwick. As the guests of the Leicestershire and Warwickshire Electric Power Company, the Midland Electric Light and Power Company, Ltd., and the Leamington and Warwick Electrical Company, Ltd., the members took tea on the lawn of Warwick Castle. At 5.15 or thereabouts they left Warwick Castle for Birmingham, and the same evening they attended a dance and cabaret entertainment at the Magnet Club of the General Electric Company. At various times the General Electric Company has organised some very good "shows," but it is doubtful if it has ever made a greater success of anything than this dance and cabaret entertainment.

The last day of the outing, Friday, June 12th, was devoted entirely to pleasure, which was perhaps just as well. The first place visited was Stratford-on-Avon, where a short time was spent—so short, in fact, that the many things of interest were not seen at all. From Stratford-on-Avon the party proceeded through Broadway to Evesham, where there was a civic reception by the Mayor of Evesham in the Council Chamber. As the guests of the Birmingham Electric Supply Department, the members then took luncheon in the Public Hall, Evesham, the afternoon being spent on the river. Back once more in Birmingham, the members were received at 9 p.m. in the Botanical Gardens, Edgbaston, by the President and Mrs. Woodhouse and the Chairman of the South Midland Centre and Mrs. Lawson, dancing subsequently taking place in the dance hall. Other attractions were music by bands of the 5th and 6th Battalions of the Royal Warwickshire Regiment, and a fireworks display, which brought the outing to a close.

ITALIAN MOTOR LINERS.

THE two largest motor passenger ships in the world are now being built at the Cantiere Navale Triestino, Monfalcone, on behalf of the "Cosulich" Navigation Company, of Trieste, for its Transatlantic service, the keel of the first having been laid on May 30th. Their leading dimensions are:—Length overall, 631ft. 3in.; breadth moulded, 79ft. 6in.; depth to main deck, 45ft. 6in.; displacement, about 26,000 tons; gross tonnage, 23,500 tons. Constructed under special survey of Lloyd's Register of Shipping and the Registro Italiano for the highest class of those institutions, the lower part of the hull is built of Siemens-Martin steel, and the upper sections of special steel with a high elastic limit. There will be five complete steel decks and one partial deck, bridge deck, promenade deck, and boat deck. All safety requirements of the Board of Trade are to be fully met. To ensure buoyancy a double bottom extends the whole length of the ship. It is built on the cellular system, and will serve for the transport of fresh water, ballast, fuel oil and lubricating oil. Besides this double bottom the hull is subdivided by ten transverse water-tight bulkheads, so arranged as to ensure floatability with three compartments flooded. Between spaces on the same deck there is intercommunication by means of water-tight doors operated hydraulically from the bridge. As fire bulkheads are provided at intervals of not more than 130ft., each separate group of accommodations may be isolated in case of emergency. The lifeboats will be adequate in number and size to take all persons on board, namely, 3000, including the crew. Some of the boats are to be motor driven, and will be fitted with wireless sets. Others will have hand-driven propellers.

The propelling machinery of each ship will consist of two double-acting four-cycle eight-cylinder Diesel engines on the Burmeister and Wain principle, developing 24,000 horse-power. This plant, which is under construction by the Stabilimento Tecnico, of Trieste, is the largest marine Diesel installation yet built. The designed speed is 20 knots. The auxiliary machinery includes three generating sets for supplying all the current required for service on board. Of these three units, two will have six cylinders and one three cylinders, the first two with an output of 900 kilowatts each and the third of 450 kilowatts.

The passenger accommodation will be most luxurious. All cabins are to be ventilated by thermo-tanks, and each will have its own telephone. In addition to passengers each vessel will be able to carry 9000 tons of cargo. There will be six cargo hatches, served by derricks operated by sixteen electrically-driven winches.

Large Transformers.

SOME time ago Ferranti Ltd., of Hollinwood, Lancashire, obtained an order from the Tata Power Company, Ltd., of India, for four 30,000-kilovolt-ampère, three-phase transformer groups, for use in connection with a hydro-electric scheme for transmitting extra high-pressure current to Bombay over a transmission line 70 miles long. Each equipment consists of three 50-cycle, 10,000-kilovolt-ampère, single-phase transformers, connected delta-star fashion and designed for a voltage ratio of 11,000/118,800 volts, with the neutral point earthed. The transformers are of the forced cooled oil-immersed type, the oil being circulated by means of electrically driven pumps through the transformers and through separate water-tube coolers.

FIG. 1—H. T. COILS FOR A 10,000 K.V.A. TRANSFORMER

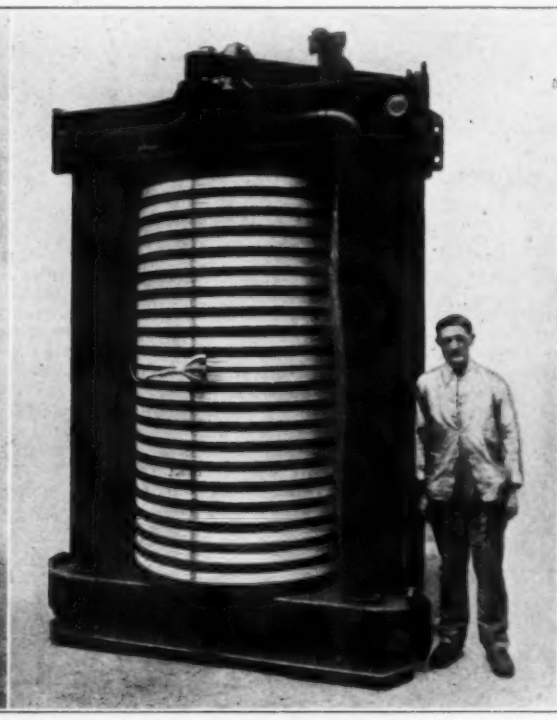


FIG. 2—TRANSFORMER ASSEMBLED

FIG. 3—COMPLETED TRANSFORMER

Each group of transformers is also provided with a conservator vessel to maintain the head of oil above the top of the tanks, and to reduce the surface of the oil in contact with the atmosphere. Air is admitted and emitted through a Ferranti patented oil-sealed calcium chloride breather, which extracts the moisture from the internal air, whilst the carbide is protected from moisture in the external air. Provision is made for filtering the air on site. Each transformer is also fitted with a dial type thermometer, with contacts for operating an alarm device in the event of excessive temperature.

Although cooling apparatus has been provided for each group of transformers, each cooling equipment can be made to serve for two groups of transformers, if necessary. Indicators inserted in the oil pipes make it possible to ascertain whether the oil is flowing.

The laminations forming the core are interlocked at the corners by heavy square steel bolts, and the amount of steel that is not required for the magnetic flux is reduced to a minimum without sacrificing mechanical strength. By means of patented spring coil clamps inserted midway in the extra high-tension windings, any slackness that might arise through shrinkage is prevented, whilst the application of excessive pressure during assembly or during service or as the result of thermal expansion is also obviated. The illustration—Fig. 1—shows the high-tension coils for one of these 10,000-kilovolt-ampère single-phase oil-immersed, forced cooled transformers; Fig. 2 a transformer assembled with the outer insulating shield surrounding the windings; and Fig. 3 a transformer complete. On the B.E.S.A. rating, each group of these transformers has a capacity of 46,500 kilovolt-ampères.

Railway Matters.

THE Minister of Transport has recently made the Liverpool Corporation Light Railways Order, 1925, authorising the construction of a light railway in the City of Liverpool in connection with the existing tramways undertaking.

A LOCOMOTIVE engine built by George Stephenson in 1823 has been sent from Hetton Colliery, Durham, to the Darlington shops of the London and North-Eastern Railway Company, in order to take part in the forthcoming railway centenary celebrations.

IN this column of June 27th last year we mentioned that the 11.45 p.m. express from Euston to Glasgow travelled from Carlisle over the Glasgow and South-Western route, *via* Dumfries, and at Strathbungo passed on to the Caledonian line to reach Glasgow Central. The train has now two portions; one goes to St. Enoch's Station, and the other, *via* Beattock and the original route, to the Central Station.

THE agreement arrived at by the sectional councils on the Great Western Railway provides that all casual, temporary and supernumerary men shall be dismissed before the regular staff. When any of the latter have to be discharged, those with the shortest service must be dispensed with first, but every endeavour will be made to find redundant members of the regular staff work at other stations in the same district or division. Such men are to be reinstated in their former or equivalent positions as soon as opportunity presents. Reductions in grade will be made according to seniority in the grade and not according to seniority of service. When a man is reinstated, the time of his absence from the company will be treated as though the service had been continuous. Similarly, a man who is reduced in rank and subsequently restored, will not suffer by the reduction.

AT a meeting of the Committee on Industry and Trade, held on Wednesday, June 17th, 1925, evidence was given by Mr. C. N. Goodall, O.B.E., managing director of Robert Stephenson and Co., Ltd., and Mr. Alec Campbell, O.B.E., chairman of the Hunslet Engine Company, Ltd., on behalf of the Locomotive Manufacturers' Association. The witnesses stated that the condition of the industry could only be regarded as desperate. The main factors that had brought about this state of things were:—(*a*) The world-wide increase in the productive capacity at present devoted to locomotives; (*b*) the inadequacy of available markets to absorb such production; (*c*) the consequent ruthless competition, both internal and foreign, which in this country was rapidly exhausting the capital resources of the establishments engaged in locomotive manufacture; (*d*) the high costs of production in this country; (*e*) the absence of support from home railways, such as would enable the industry to meet foreign competition on better terms.

ON page 649 of our issue of June 12th we stated that the railway companies had had to prove to the Railway Rates Tribunal that, as required by Sec. 58 (1) of the Railways Act, 1921, they had given "efficient and economical working and management." That phase disposed of, the companies were faced with the presentation of another difficult case. They had to show what capital works executed prior to January 1st, 1913, had not been adequately remunerative. The evidence given by Sir Ralph Wedgwood on that point affords ample corroboration of the extravagance indulged in by competitive schemes. The Great Central extension to London, opened in 1899, was such a case, and the Great Western and Great Central Joint Line through Wycombe, opened in 1906, was another. Neither the Hull and Barnsley nor the Lancashire, Derbyshire and East Coast had paid for their construction. Similar tales were told by other witnesses of the Liverpool and Southport electrification, the Midland Hotel, Manchester, and the South London electrification of the London, Brighton and South Coast.

ACCORDING to the Board of Trade returns, the value of the railway material exported during the first four months of the present year was as follows, the corresponding figures for 1924 and 1923 being added in brackets:—Locomotives, £1,195,610 (£794,292, £1,149,021); rails, £612,775 (£631,131, £813,786); carriages, £542,222 (£358,316, £422,093); wagons, £1,075,094 (£1,325,816, £999,504); wheels and axles, £218,606 (£257,513, £346,591); tires and axles, £152,256 (£233,467, £145,065); chairs and metal sleepers, £248,425 (£564,672, £261,291); miscellaneous permanent way, £486,874 (£450,781, £364,890); total permanent way, £1,765,522 (£2,225,514, £2,017,205). The weight of the rails exported was 63,239 tons (70,033 tons, 90,605 tons), and of the chairs and metal sleepers, 20,473 tons (4417 tons, 22,808 tons). During the month of April last locomotives of the following values were shipped to the countries named:—India, £168,888; the Argentine, £22,118; other countries in South America, £17,647; Australia, £7026; and of rails as follows:—The Argentine, £55,770; South Africa, £7462; West Africa, £7262; India, £3911; New Zealand, £2323; Ceylon, £2073.

NOT until within the last ten years or so has any railway officer of the highest rank condescended to address a communication to the Press when his company's actions have been challenged. The first general manager to do so, as far as we remember, was Sir Percy Tempest—an engineer, by the way—and since then Sir Herbert Walker has, on one or two occasions, followed suit. Nothing has, however, equalled the letter on third-class sleeping cars that appeared in *The Times* of Friday, the 5th, over the signature of Mr. William Whitelaw, the chairman of the London and North-Eastern Railway, and Sir Guy Granet, the chairman of the London, Midland and Scottish Railway. The purpose of the letter was to contradict the assertion in an earlier communication that the latter company was preventing the East Coast route from providing third-class sleepers. It proceeded to say that it had not been found possible, on economic grounds, to provide such accommodation. The letter does not explain what those economic grounds were, nor was it likely that they would be indicated. We would, however, repeat what we have said on previous occasions, and that is that the majority of the season tickets issued between England and Scotland are first class in order that their holders may have the benefit of the sleeping accommodation.

Notes and Memoranda.

ACCORDING to the *Financial Times* excavation at Winslow, Bucks., has revealed a good seam of coal at no great depth. So far, it is an outcrop that has been laid bare, but it is believed to be a true outcrop of a fine coal seam some 3ft. thick and of a bituminous character.

THE flying boat which is being built in America for Mr. Harold Vanderbilt is to be fitted with an Irkham-Napier engine. The flying boat is built of corrugated duralumin, and with a cabin to carry five passengers. She is expected to have a speed of over 160 miles an hour, and is claimed to be the first privately owned flying boat.

SOME tests carried out in Oklahoma on the flow of water through some long concrete pipe lines gave the value of C for Hazen-Williams' formula as 145.4 for 6.6 miles of 60in. pipe having 29 bends aggregating 455.7 deg.; 152.4 for 15.3 miles of slightly sinuous 60in. pipe, and 152.1 for 4 miles of nearly straight 54in. pipe. The corresponding values of n in Kutter's formula were 0.0111, 0.0107 and 0.0106 respectively.

AN unusual case of pile deterioration is reported in the *Engineering News-Record*. The power station at Portland, Oregon, which was built in 1910, was founded on piles, on the top of which there was poured 3ft. of concrete. In spite of this thickness of material, together with 2ft. of earth, heat penetrated from the ashpit to such an extent that the piles were charred and had to be replaced. The ashpit temperature is said to have been 700 deg. Fah.

THE British Engineering Standards Association has issued a new standard specification for bus-bars and connections—No. 159, 1925. Early last year the Association issued a standard specification for marking switchboard bus-bars and connections and the new specification refers to the quality of metal, limits of temperature rise and current density, joints between conductors, and also includes recommended sizes of flat and round bars, both for copper and aluminium.

IT was recently stated that the microphone used for broadcasting the chimes of Big Ben was enclosed in a biscuit tin stuffed with straw and hay. This, the *Wireless World* points out, is not correct. Originally a carbon microphone was used inside a biscuit box filled with cotton-wool and sealed up, to make it air and water-tight, but for the past ten months the microphone has been wrapped round with cotton-wool and enclosed in a football bladder sealed up hermetically with rubber solution to guard against the inclemencies of the weather to which otherwise it would be continually exposed in its lofty position in the clock tower at Westminster. The bladder is suspended from one of the iron rafters, approximately 15ft. above the bells.

STATISTICS of platinum and allied metals of the mineral industry of the British Empire and foreign countries, issued by the Imperial Mineral Resources Bureau, show that in 1922 70,400 crude troy ounces of platinum metals was produced in the world, against 45,000 in 1921 and 50,000 in 1920. Of this figure 1400 oz. was produced in the British Empire. In 1922 6624 oz. of unrefined platinum was imported into the United Kingdom, 38 oz. of which was from the British Empire, against 1849 in 1920, the total exports and re-exports being 1374 oz. in 1922 and 291 in 1920. The refined platinum imports for 1922 are shown as 2530 oz. against 879 oz. for 1920, the total exports and re-exports being 1873 oz., against 4595 oz. for 1920. The U.S.A. imported 94,591 oz. and exported 1456 oz. in 1922.

THE Electricity Supply Commission of South Africa, states a writer in the *Electrical Times*, desires the Municipality of Johannesburg to take power from the Victoria Falls Power Company instead of building a new station. Johannesburg finds this advice unacceptable, one reason being that the town would have to depend upon transmission across one of the worst lightning-afflicted areas in the world. In support of this a report by Messrs. Bernard Sankey and G. M. Clark and Partner sets out a list of interruptions in supply to Germiston, Boksburg, Benoni, Brakpan and Springs, that being practically the route of the Witbank-Brakpan transmission line. Benoni seems to have suffered eight breaks in continuity of service between December 2nd, 1924, and March 6th, 1925. But the record of interruptions for towns on the West Rand from November, 1924, to March, 1925, is longer than that; Krugersdorp was shut down on seventeen occasions during the period. The report states that the greater portion of the interruptions were probably due to lightning troubles.

A PUBLICATION on "Methods Used for Dehydration of Oil-field Emulsions," by Mr. D. B. Dow, has recently been issued by the American Bureau of Mines. Various processes are described, but the author's remarks concerning the electrical methods are perhaps of greatest interest. In this connection Mr. Dow gives the electrical action taking place which causes the separation of oil and water, the theory being due to Messrs. W. O. and H. C. Eddy. When an emulsion is subjected to the influence of a high potential alternating field, it is stated that the minute water particles, electrically charged by the field, rupture the enveloping oil films and coalesce, forming larger water droplets. This action of stress and strain, attracting and repulsion, on the conducting water particles continues until all the microscopic drops of water in the original emulsions have broken the bonds of the entrapping oil films, the larger droplets serving as nuclei until the entire water content is freed into the large drops which readily settle out. The low power requirements of the process, from the records of commercial plants, substantiate the theory that the phenomenon is that of a multitude of series condensers rather than of conducting paths. The minute water particles serve as electrodes or poles of the condensers, and the separating oil acts as the dielectric, which is ruptured by the high voltage, allowing adjacent positively and negatively charged droplets to neutralise themselves by uniting. In the Cottrell method of dehydrating oil, an alternating current at 11,000 volts is carried in the treater. The Seibert process is also an electrical process, but differs from the Cottrell process in that a direct current with a potential of approximately 500 volts is utilised. Dehydration by this process is dependent upon the migration of colloidal particles due to electrical stress.

Miscellanea.

IT is said that experiments recently made have proved that Australian eucalyptus timber is suitable for the manufacture of paper.

HOLYHEAD is to be developed by the London, Midland and Scottish Railway as a new herring port for drifters working in the Irish Sea.

IT is proposed to construct a new electric power station in Berlin, which is to have a capacity of 216,000 kilowatts by the summer of 1927, and 400,000 kilowatts at the end of 1929.

A VOTE of 1,663,000 dollars, covering the cost of maintaining and operating a dredging fleet on the St. Lawrence River Ship Channel, has been passed by the Canadian House of Commons.

DURING the past year the total number of applications for patent rights was 31,370, a decrease of 1251 as compared with 1923. The number of women inventors increased slightly to 493.

THE new electric lighting plant at Agra, India, which was started up in April, comprises two 270-kilowatt Ruston and Hornsby-Crompton sets, and one of 180-kilowatt Three-phase current is generated at 6600 volts, and is distributed by means of an overhead, four-wire three-phase system at 230 volts.

TO mark the opening of its new premises at 3, Brixton-road, S.W. 9, and to celebrate the fifth anniversary of the establishment of Atalanta, Ltd., a "shop-warming" was held at the new address on Wednesday, June 10th. The works are run entirely by women, who specialise in turning, screw-cutting, fitting, &c., to close limits.

IMPORTANT investigations on behalf of a North of England firm are being carried out in the hills, near Tomintoul (Banffshire), with a view to discovering whether manganese is present in sufficient quality and quantity to justify opening workings. It is understood that the samples so far taken have not been so satisfactory as had been hoped, but the investigations are proceeding.

THE broadcast transmitting apparatus at Marconi House—the old transmitting station of 2 LO—has been re-established and will remain constantly ready to operate as a precautionary measure, in case of any breakdown at the Oxford-street station. In eighteen months, representing 75,000 hours of transmission, there have been only three breakdowns of the apparatus, two of which occurred in a period of ten days.

THE Madras Government is undertaking an extensive irrigation project in Malabar covering 50,000 acres to serve the rich rice producing talukas of Palghat and Walluvanad. The waters of the Kalpathi River will be harnessed. The area of the water surface will be about 300 acres. There will be a 60ft. dam capable of accommodating 1082 million cubic feet of water. The scheme, which is estimated to cost Rs. 35 lakhs, will, the experts say, be a financial success.

A NEW 5000-kilowatt Metropolitan-Vickers turbo alternator is being installed in the Alice-street power station of the Durban Municipality. The present working pressure at the stop valve is 150 lb. per square inch, with a superheat of 100 deg. Fah., although the set can be modified by the addition of new nozzle blocks, wheels and diaphragms, to work at a pressure of 325 lb. per square inch, with 700 deg. superheat, if required in the future. The turbine is direct-coupled to a three-phase alternator designed for an output of 5000 kilowatts at .8 power factor, 6600 volts, 50-cycles, and running at a speed of 3000 revolutions per minute.

ACCORDING to Mr. H. W. Clayden, president of the South African Institute of Electrical Engineers, South Africa is now producing more than sufficient base metals in the form of tin, copper and lead to supply its requirements, and there is no reason why, given the cheap power which will be available in the Witbank area, sufficient electrolytic copper should not be produced to fill all South African requirements for overhead copper conductors, copper wires and rods. The difference in cost of the double shipment of copper to Europe and manufactured wire back to the country, should be sufficient to cover the increased cost due to the manufacture on a small scale.

A RETURN by the National Federation of Iron and Steel Manufacturers shows that the production of pig iron in May amounted to 568,000 tons compared with 569,800 tons in April and 650,900 tons in May, 1924. The furnaces in blast at the end of the month numbered 157, a decrease of one since the beginning of the month and a decrease of 34 compared with the number in blast at the end of May, 1924. The production included 170,200 tons of hematite, 200,300 tons of basic, 138,700 tons of foundry and 26,500 tons of forge pig iron. The production of steel ingots and castings amounted to 651,600 tons compared with 597,600 tons in April and 809,700 tons in May, 1924.

AT present, states the *Wireless World*, Belgium only possesses one broadcasting station, namely, that at Brussels, which transmits daily on a wave length of 265 m. with an input of 1½ kilowatts. The station is owned by a private company working under a Government concession on similar lines to the British Broadcasting Company, income being derived from the sale of receiving licences, which are obtainable through the Post Office. These licences cost 20 francs per annum, or about 4s. 3d. at the present rate of exchange. There are no limitations as to the length of aerials, the only restriction imposed being a law prohibiting their erection over public thoroughfares.

ACCORDING to the *Board of Trade Journal*, an exhibition of radio apparatus is to be held at Zurich from August 14th to 23rd. Although the regulations demand that exhibitors should be upon the Swiss Commercial Register, foreign goods may be exhibited through the medium of qualified Swiss agents. British manufacturers who desire to display their goods should communicate with their local agents, or, if they have no local agents, with Dr. S. Guggenheim, president, Verband, Schweizerischer Radio-Haendler, 3, Bahnhofplatz, Zurich. In his recent report Mr. Sperling, the British Minister at Berne, stated that there were openings in Switzerland for British radio and telephone apparatus.

THE QUEEN MARY RESERVOIR AT LITTLETON—INTAKE WORKS

MR. HENRY E. STILGOE, M. INST. C.E., LONDON, ENGINEER

(For description see page 672)

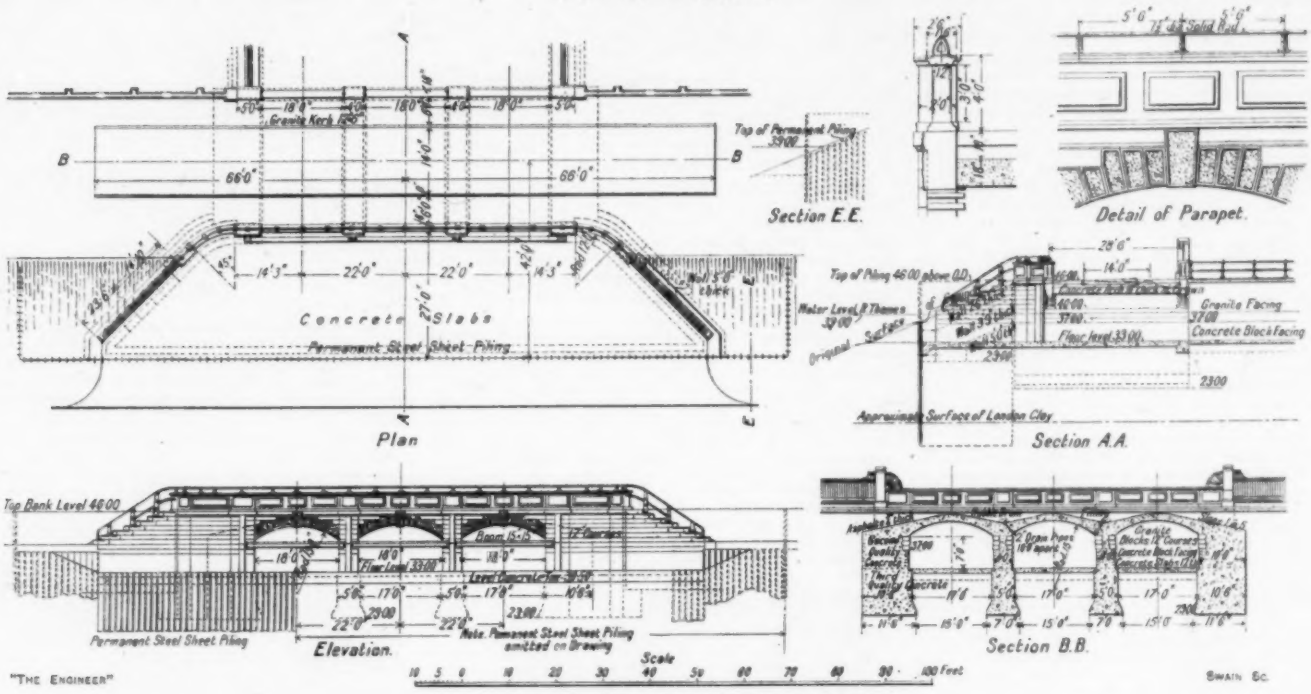


FIG. 10—PLAN, ELEVATION AND SECTIONS OF INTAKE

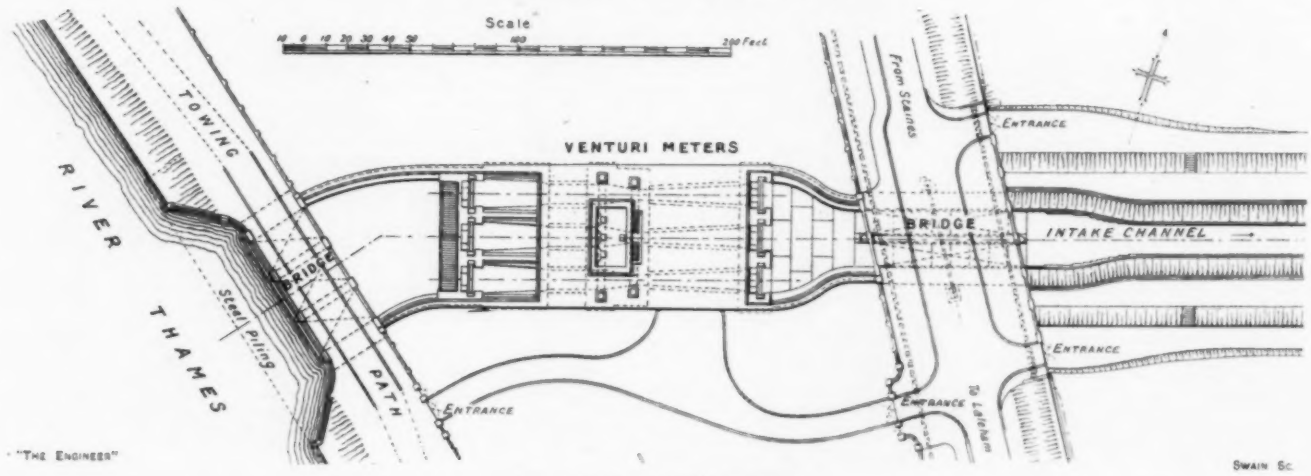


FIG. 11—PLAN OF INTAKE WORKS

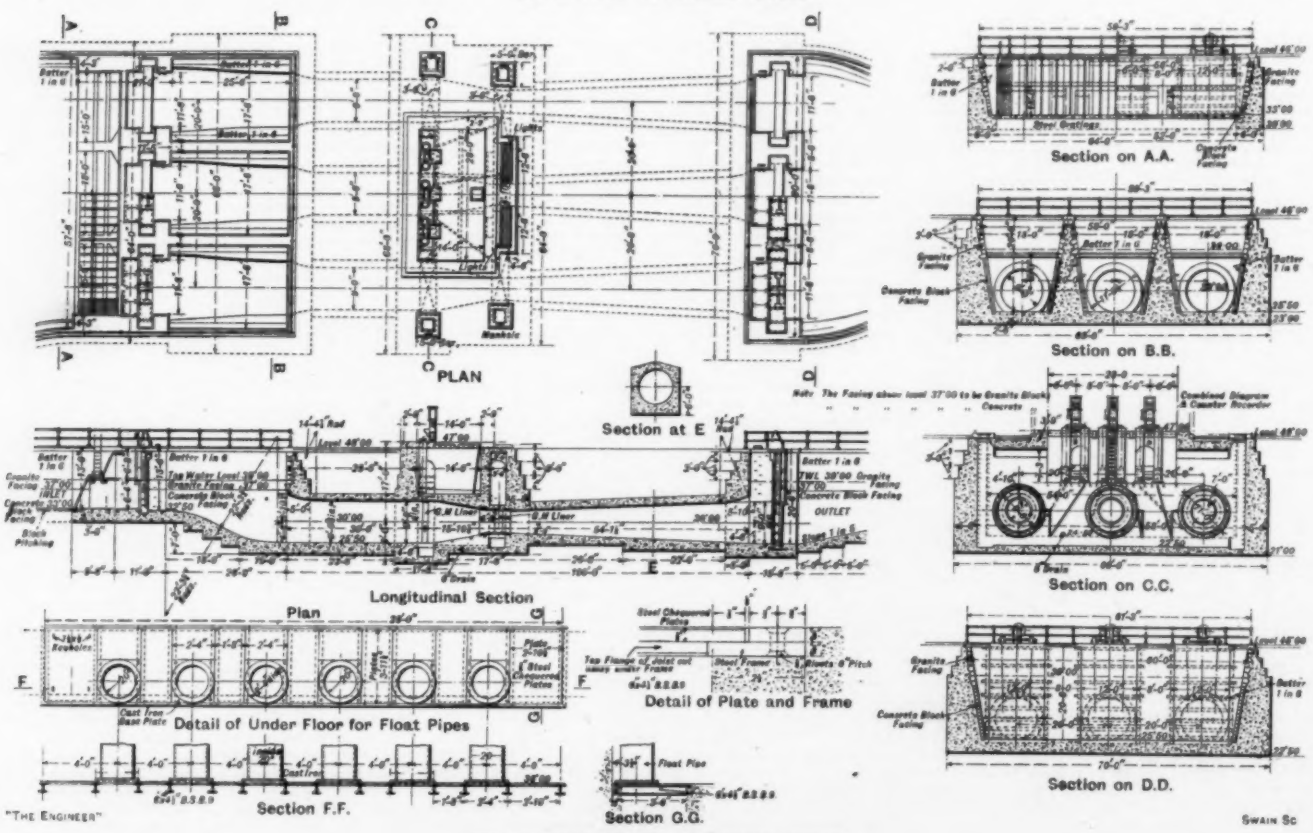
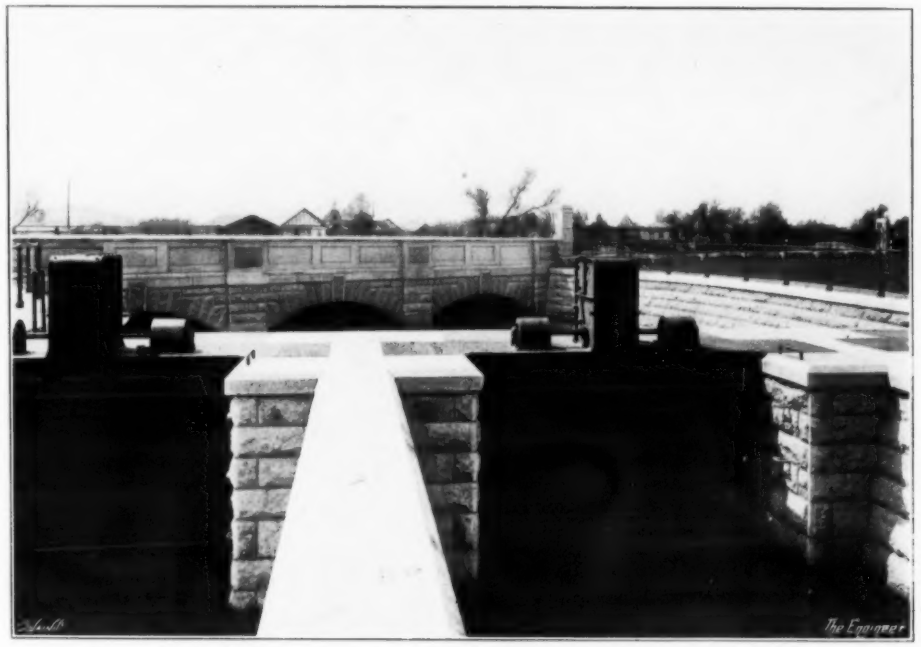


FIG. 12—ARRANGEMENT OF VENTURI METERS

QUEEN MARY RESERVOIR AT LITTLETON—INTAKE WORKS

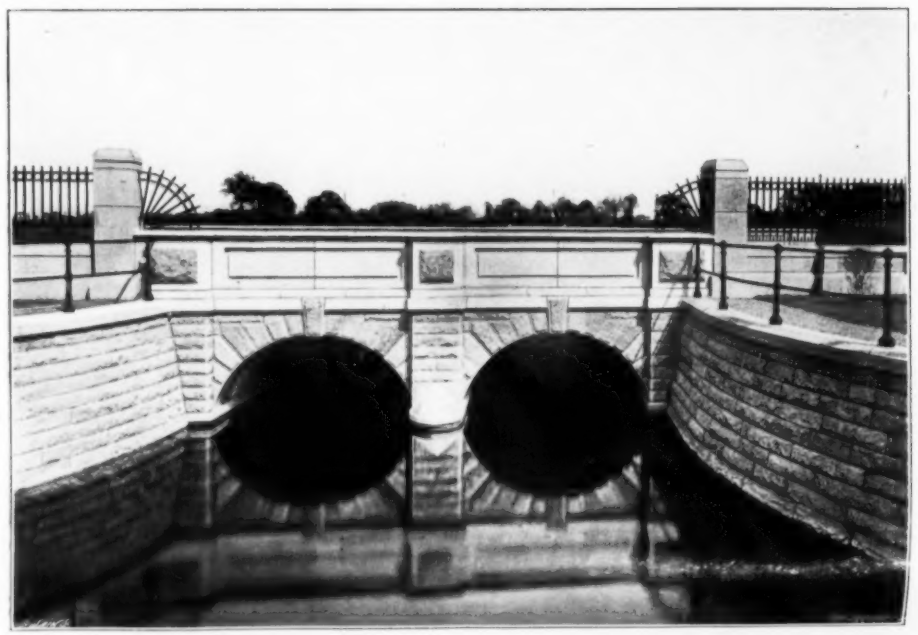
MR. HENRY E. STILGOE, M. Inst. C.E., LONDON, ENGINEER

THE INTAKE NEAR PENTON HOOK, FROM THE RIVER

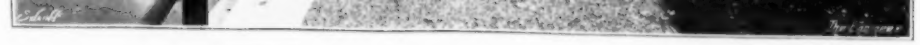


INTAKE ARCHES AND SLUICES FROM THE LAND SIDE

INTAKE SCREENS AND SLUICES, AND VENTURI METER HOUSE



BRIDGE CARRYING STAINES-LALEHAM ROAD OVER INTAKE CHANNEL

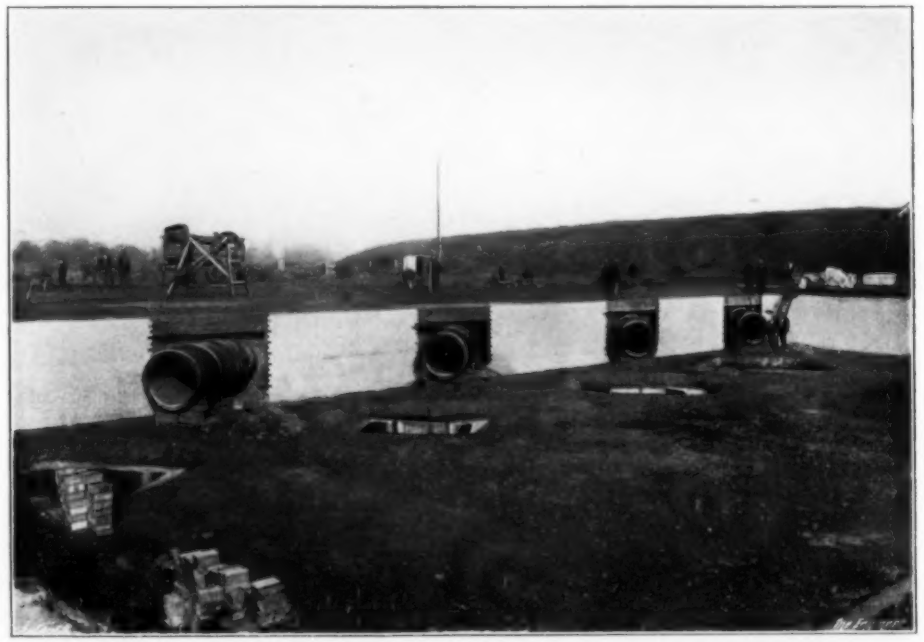


INTAKE SCREENS AND SLUICES, AND VENTURI METER HOUSE

BRIDGE CARRYING STAINES-LALEHAM ROAD OVER INTAKE CHANNEL

ACCOMMODATION BRIDGE OVER INTAKE CHANNEL

CURVED PORTION OF CHANNEL AND LALEHAM-ASHFORD ROAD BRIDGE



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TWO-PAGE SUPPLEMENT—QUEEN MARY RESERVOIR AT LITTLETON: INTAKE WORKS.

THE ENGINEER.

JUNE 19, 1925.

The International Railway Congress.

THOUGH our former peaceful days have not yet returned, the years now pass more quickly than did those of the war period. Thus it seems but a few months since we were discussing the ninth session of the International Railway Congress held in Rome three years ago. According to custom the next meeting should not have taken place until 1927, when it would have been held in Madrid. But soon after the decision to accept the Spanish invitation it was felt that a congress in London in the centenary year of public railways would be more appropriate, and the Spanish Government being willing to postpone its invitation until 1930, the meeting in London was arranged. So, after an absence of thirty years, the Congress holds its tenth session in this country and begins business on Monday next. For the following nine days the delegates, in five sections meeting simultaneously, will discuss reports on seventeen subjects connected with the railways of the British Empire, Northern America, France, Belgium, Italy, &c., prepared by fifty-three reporters, all of whom are officers of high rank in their respective spheres. The Congress will formally close on Thursday, July 2nd, when those members who are so disposed will go to Darlington to assist in the centenary celebrations of the opening of the Stockton and Darlington Railway, which are to be held there.

From the summaries that appeared in our last two issues and are concluded to-day the value of the reports presented to the Congress will be appreciated. Owing probably to the intervening period having been reduced from five to three years the subjects are fewer than on former occasions, and the information is mainly confined to the British Empire, America, and the leading continental countries. The practice in various phases of civil, mechanical and electrical railway engineering and in railway operation in every part of the world is recorded. Such information is not to be found elsewhere, and is given with a wealth of detail that is astounding when one remembers how very loath many railway officers are to afford information as to their methods and the results obtained therefrom. Take, for instance, the reports we summarised a fortnight ago. In one Mr. Coomber tells why mechanical apparatus for packing the sleepers is not used; why slag ballast is not employed for tunnels, and why one company will not have it on its electrically operated railways. He tells us also how the maintenance on two branches has been reduced by employing only one gang of men and letting the passenger trains stop when and where required to pick up or set them down. In other reports we find notes on the use of mechanical track laying plant in France and America. Then, a week ago, in a continental report, it was shown that efforts were being made to reduce the cost of protecting the crossings of railways over public roads. That step struck us as significant in view of the terrible and yearly increasing death-roll in the United States from motor cars being struck by trains. On the very important subject of the cost of traction—which, we agree with Sir Henry Fowler, who is one of the reporters thereon, is one which until late years appears to have received less attention than any other branch of rolling stock engineering—Mr. Collett gives some useful information about oil fuel and shows that the comparative efficiency of oil and coal in India is as 100 per cent. and 56.5 per cent., but that, nevertheless, it is not economical to use it where coal is reasonably cheap. The American reporter on lubrication gives some information that will be news to many. It is that in the United States the railway companies do not buy oil for lubrication, but make a contract on a 1000 miles basis with an oil company to supply and apply the lubricant for locomotives, passenger and freight cars. Useful points on the same subject were quoted by us last week from Sir Henry Fowler's report. Mechanical lubrication on locomotives, for instance, saves from 12 to 50 per cent. oil as compared with feed lubrication. The American reporter, by the way, said that mechanical lubrication was little used in his country. The reason is perhaps not unconnected with the fact that the companies do not buy their lubrication and are not therefore so much interested in possible economies therein. These few notes give but a bare idea of the enormous amount of valuable information which is put before the Congress.

In view of the technical value of these reports and of the discussions they provoke and, still more, of the benefits to be derived from meeting fellow railwaymen from all parts of the world, it is to be regretted that the percentage of the delegates who are directors and not officers is in some cases on the high side. Each railway company is only allowed to send a number of delegates which is limited by the mileage of the company, and every director must therefore take the place of a technical man. We note, to take an example, that of its thirty delegates, the London, Midland and Scottish Railway sends thirteen of its twenty-five directors, and the Great Western Railway, which has twenty-three places, sends ten of its twenty-four directors. The Southern does better. Eight of its total of twelve places are filled by officers, and there are only four out of its eighteen directors. Better still is the London and North-Eastern. It has twenty-six directors, but only sends six, who are accompanied by eighteen officers. Another point which we venture to suggest might receive the consideration of the Congress is its attitude towards the public. The present Congress is not quite a private affair, meeting here by the invitation of the Railway Companies' Association. It is more or less a Government affair, for the British Government sends twenty delegates, and the governments of other countries are interested, as all subscribe towards the administration and upkeep of the Congress as a body. In these circumstances the admission of the public to the meetings might be considered.

Gas Engineers and the Electrical Subsidy.

ONE of the outstanding features of the annual meeting of the Institution of Gas Engineers which was held in London last week was the unhesitating belief of the members in the future of the gas industry. The business of supplying towns gas in any particular area is, of course, something approaching a monopoly, but the monopoly to-day is of a very restricted nature, owing to the intensive competition which exists between the two great services responsible for meeting the public demand for light, heat and power. It is in this competition with electrical energy that can be traced the origin of the renascence which began to show itself in the older industry at the beginning of the present century, and to which must almost solely be ascribed the remarkable increase in the amount of gas consumed, the vast improvement in the appliances in which it is used, the attention which is given to the requirements of the consumer, and, to no little extent, the improvement in the amenities of life owing to the better condition of the atmosphere surrounding our cities.

The gas engineer would, in fact, be the first to acknowledge the debt which he owes to the so-called rival industry, and perhaps one of the most reassuring and agreeable signs of the times is to be found in the feeling of good will and a certain measure of interdependence which has grown up between the representatives of the two industries. The gas engineer to-day makes no endeavour to

conceal that for certain of his own manufacturing processes the suitability of electrical power is undeniable, while, on the other hand, the electrical engineer has in some cases rather proudly boasted that in the matter of the supply of solid fuel the gasworks have been instrumental in enabling him to produce his units economically. As an example, we might mention the recently concluded contract between the London County Council and the South Metropolitan Gas Company, providing for supplies of coke by the latter undertaking to the Greenwich power station to the extent of some 3000 tons per week. At least it can be said that the narrow-minded feud between the two industries which was so bitter in the earlier days of the struggle has died a natural and well-merited death, and although each keeps an alert eye on the other's activities, it is properly realised that there is ample scope for both, and that the true way to progress lies in judicious liaison rather than mutual antagonism. It is for this reason that we view with some misgiving a leaning, let us call it, in Governmental quarters to treat preferentially the electrical industry. The gas industry has always been the butt of legislation, while, if proposals now current are carried into effect, the electrical industry may be in danger of appearing as the pampered child, so that the old rifts between the two may well be reopened, to the detriment of both. The outstanding topic of discussion at the Gas Engineers' meeting in London was the proposed grants of Government subsidies to enable the supply of electricity to be extended and possibly cheapened. Whether the provision of subsidies of the kind is a right or wrong principle is not for us to determine, but on mere ground of equity it would seem that equal treatment should be meted out to both industries. Mr. Ferguson Bell, the President of the Institution of Gas Engineers, made the feelings of the gas industry pretty plain when in his address last week he pointed out that artificial stimulus to any industry by State aid is essentially contrary to the financial or fiscal policy of this country, and constitutes no less than a form of domestic or internal protection at the expense of other industries.

Perhaps, however, the right policy when considering the public services is to regard the whole matter from the point of view of the welfare of the public. If the population as a whole is going to benefit from the provision of subsidies, then it is easy to argue that the principle is a right and just one. This, albeit, is a matter which time and experience alone can prove, in spite of all the hosts of technical and commercial arguments which all sides show no difficulty in marshalling in support of their respective causes.

The Internal Combustion Turbine.

TECHNICAL interest in the problem of the internal combustion turbine is still maintained, but in the absence of any practicable method of securing high compression—the crux of the matter—there is little prospect of competing with the reciprocating engine in point of thermal efficiency. In this respect, the reciprocating internal combustion engine possesses what may be justly regarded as one of the most beautiful features in mechanical engineering, in that the combustion chamber and driving piston constitute also the compression pump. There is no loss through transferring the mixture, pumping losses are reduced to an absolute minimum, and the efficiency of compression exceeds 90 per cent.

In the case of the gas or oil turbine, twenty years of patient research by many experimenters have failed to reveal any promising method of avoiding the use of a rotary compressor and separate combustion chamber; and the characteristic inefficiency of the rotary compressor at very high speeds, coupled with the losses in transferring the gases, puts entirely out of court any prospect of securing high compression by this method. The reciprocating or pump type of compressor, too, can offer nothing, and must be ruled out by its bulk and the difficulties and inefficiency of any method of gearing from the main shaft of the turbine. Thus faced with what leading authorities on internal combustion regard as practically an insoluble problem, serious experimenters who remain in the field deserve considerable credit for their persistence; and especially noteworthy have been the efforts of Holzwarth, over a period of fifteen years. This patient experimenter has produced several machines, each of which has embodied some slight advance on its predecessor, in point of thermal efficiency. But there is another field open to experimenters who realise the impossibility of obtaining high compression. It is to develop low-pressure machines. Thermal efficiency is far from being the only criterion by which the practical utility of a prime mover can be judged. Initial costs, costs of upkeep and repairs, wages, durability and fuel costs, must all be considered, and in engineering there are many instances of machines of low efficiency which, by reason of advantages in other respects, have proved more economical than machines of higher efficiency. This is no paradox to the engineer who is able to dissociate efficiency from economy, and it may be that, although its thermal efficiency may not exceed 50 per cent. of that of the reciprocating engine, the low-pressure internal combustion turbine will yet come into its own with advantage for certain purposes. Its field will probably be very restricted, and, having regard to the exigencies of an ultimate depletion of fuel resources, it might only be of temporary utility, seeing that thermal efficiency would assume a higher relative importance among the other criteria of economy.

The attraction of research on the internal combustion turbine lies undoubtedly in the prospect of adiabatic expansion down to atmospheric pressure—a prospect not offered by the reciprocating engine—and also in recognition of the fact that a complete solution of the problem would provide a combination of the characteristic advantages possessed by the steam turbine with those of direct combustion. But it will be seen that under present conditions there is a too heavy debit balance of fuel consumption, and the advantages of direct combustion are nullified by the inefficient method of compression and by the transfer of the mixture.

Conversazione of the Institution of Civil Engineers.

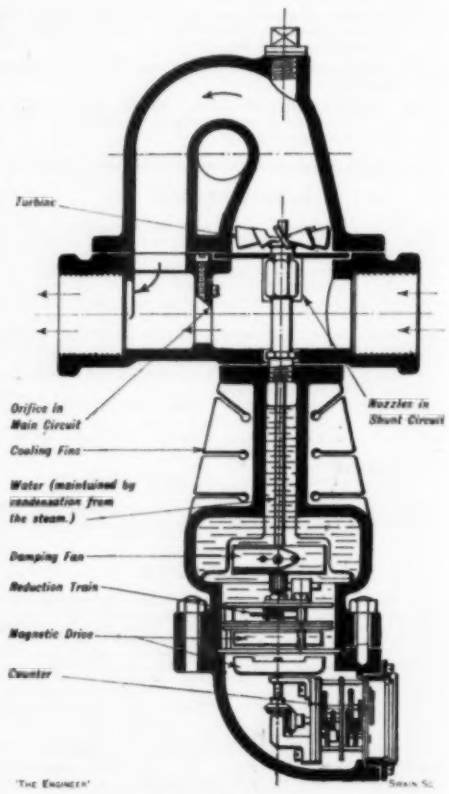
THE Conversazione of the Institution of Civil Engineers was held in the Institution's building, Great George-street, Westminster, on the evening of Wednesday last. A very large gathering of members and guests was received by the President, Mr. Basil Mott, assisted by Mrs. Adrian Mott and Mrs. Mark Mott, and the Council.

During the evening three lectures were given, one by Sir Henry Fowler, K.B.E., M. Inst. C.E., on "The Progress of the Steam Locomotive During the Last Century;" the second by Sir W. Sefton Brancker, K.C.B., on "Air Transport;" and the third by Mr. N. E. Odell, on "Reminiscences of the Mount Everest Expedition, 1924." An excellent musical programme, in which a portion of the Band of H.M. Royal Artillery, and the Catterall String Quartet took part, had been provided. As usual, the floral decorations were charming, and altogether a most enjoyable evening was spent.

Among the exhibits presented for the edification of the guests, chief interest must, we think, be accorded to the wonderful collection of old engravings, letters, time-tables and other documents illustrating the history of English railways from 1821 to 1850, which Mr. Isaac Briggs showed in the upper Committee room. Included in the collection of original letters were many from George and Robert Stephenson and J. K. Brunel. One of George Stephenson's was particularly interesting. It was dated May 19th, 1821, was addressed to Edward Pease, and advised the use of wrought iron rails. Another document of great historical importance was the original estimate for the Liverpool and Manchester Railway, dated February 5th, 1825, and signed by George Stephenson. There was a caseful of early Bradshaw time-tables, among which was a copy of the rare first London edition dated October 25th, 1839. Included amongst the old engravings was a portrait of Matthew Murray, said to be the only one in existence. Several of the engravings showed old-time railway construction methods. It was with surprise that we noticed, in an otherwise excellently staged exhibit of historical relics, some photographs showing modern methods of railway construction and machines therefor inserted amongst the old prints. We venture to suggest that these exhibits were not quite in keeping with the remainder.

The scientific and technical exhibits were shown in the library on the first floor. Among them were several which we saw at the Conversazione of the Royal Society a month or so ago. Professor J. G. Gray, of Glasgow University, exhibited a collection of gyroscopes and gyroscopic apparatus, including some "performing boxes" and two gyroscopic cars that were raced on a small flat board. Dr. J. S. Owens exhibited his "settlement dust counter" for examining coarse dust, such as occurs in grain unloading stations. The Ordnance Committee, Woolwich Arsenal, demonstrated the "trajectograph," an instrument for graphically computing the flight of a projectile in a resisting medium, while the Research Department of the Arsenal showed the flight of bullets by means of spark photography. Mr. F. Gill exhibited the International Western Electric Company's three-valve electrical stethoscope, whereby up to 600 persons can listen simultaneously to the heart-beats and other body sounds of a patient. Mr. F. W. Davey showed his instrument for describing parabolic curves, an account of which was given in our issue of May 22nd.

A new device for metering steam was exhibited by Mr. J. L. Hodgson. This device, the Kent-Hodgson turbine steam meter, is claimed to provide a means, neither costly nor complex, for metering the steam flowing in small mains. A cross section of the device is given herewith. Steam discharged from the nozzles impinges on a turbine, the speed of which is kept low by means of a damping fan rotating in a liquid. The retarding torque at any given speed produced by the damping fan is made so great that any variation in the retarding torque arising from the turbine, caused by variations in the density of the steam, is negligible. The turbine therefore rotates at normal flows with a speed which is proportional to $Q/\sqrt{W}$, where Q is the weight of steam passing per second, and W is the density of the steam in pounds per cubic foot. From the equation, it follows that a 2 per cent. change in the density of the steam involves a 1 per cent. correction to the flow reading. The use of a damping fan greatly reduces the wear on the pivots, and also, since it increases the relative velocity between the impinging steam and the turbine, increases the range of the meter. Except at very low flows, when the pivot friction makes itself felt, the ratio of the revolutions per minute to the rate of flow is constant for the meter. Among the special features claimed for the meter are the following:—There is only one bearing exposed to the steam and on



STEAM METER

it there is no side thrust, the counter, being below the main and being protected by radiating fins, remains cool; and there can be no leakage of steam or water into the counter chamber, because of the magnetic drive employed. The maximum flow which the meter will measure can be altered by changing the orifice plate. The size of the meter exhibited could in this way be arranged to pass any maximum flow between 500 lb. and 5000 lb. of steam per hour. It is further claimed that the meter will register accurately down to one-tenth or one-fifteenth of the set maximum. By fitting a blank plate in place of the orifice plate and putting the meter in a shunt circuit across an orifice, the largest steam mains may be metered at small cost. A simple addition to the meter enables the counter record to be transmitted electrically to any distance.

Mr. R. L. Quertier showed the Reavell rolling drum rotary air compressor in an improved pattern, as now being used for supplying air to the air locks for the new Underground Railway tunnel at Charing Cross, London. This compressor, of an earlier form of which we published a description some time ago, is provided with eight sliding blades. At 750 revolutions it can supply 1000 cubic feet of air at a pressure of 20 lb. Its outstanding features are its small size for its capacity and its speed which is high enough to permit of its being direct coupled to an electric motor. A small electrically driven rotary compressor based on a similar principle was also exhibited by Mr. Quertier. This example was designed for use in hospitals and laboratories for the removal of liquids by suction or the supply of antiseptics or anæthetics under pressure.

Professor S. M. Dixon demonstrated the construc-

tion and action of his cement spraying apparatus. This machine throws cement mortar by means of a jet of compressed air. The mixture is blown through a rubber tube, 2½in. in diameter, without a nozzle. Ordinarily, a mixture of 6 to 1 strength in a fairly dry condition is used. The coating hardens immediately after projection. About one-third of the sand falls down and can be used again. The air required is 200 cubic feet per minute at a pressure of 3.5 atmospheres, and the amount of mortar thrown is 1 cubic yard per hour. Professor Dixon also exhibited a somewhat similar device, the stucco gun, a piece of apparatus designed to throw cement mortar of 1 to 3 strength with a little lime added to it. This gun operates by means of an electrically driven paddle. Samples of expanded metal coated by means of the cement mortar sprayer and by means of the stucco gun were shown.

The near approach of the railway centenary celebrations no doubt accounted for the presence among the exhibits of some photographs and other illustrations of early locomotives. Mr. J. H. R. Whinfield showed some prints of a road locomotive built by his ancestor John Whinfield, of Gateshead, about the year 1804. Photographs of early trains, dating back to 1835, were exhibited by the Locomotive Department of the Belgian State Railways, and drawings and photographs of early Danish locomotives, almost all supplied from this country between 1847 and 1869, were shown by the Danish State Railways. The Danish engines supplied from this country were built, we noticed, by Sharp Brothers and Co., of Manchester (1847 and 1864), R. and W. Hawthorn (1856), Chaplin, of Glasgow (1869), Stephenson (1868), and the Canada Works, Birkenhead (1862). Drawings were also shown of Crampton locomotives built for Denmark in 1856 by R. and W. Hawthorn and by Borsig, of Berlin.

The Swiss State Railways exhibited a model of a 4–2–0 tender locomotive built in 1847 for the former Swiss Northern Railway. Mr. F. A. Cortez-Leigh showed a model of the London and North-Western Lady of the Lake engine, built at Crewe in 1858. A double-handled cup, with early views of the railway at Derby, was shown by Sir Henry Fowler.

The Museum on the second floor, which contains the collection of specimens illustrating deteriorations of structures exposed to sea action, was also open for inspection.

Literature.

Ships of the Royal Navy. By OSCAR PARKES, O.B.E. Sampson Low, Marston and Co. 3s. 6d. net.

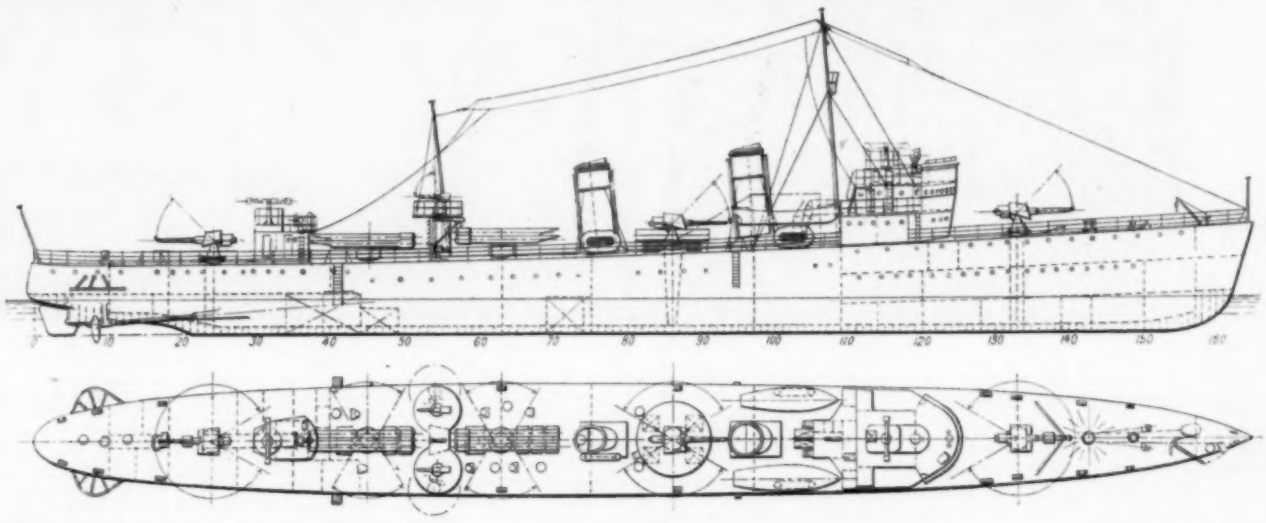
THE latest edition of this handy volume makes a timely appearance, for public interest in naval affairs will be stimulated by the new shipbuilding programme soon to be announced. Differing from the conventional popular guide to His Majesty's ships, this book not only lists and illustrates all the vessels comprising our post-war Fleet, but furnishes a great many interesting notes on their design, their record of service, and their behaviour at sea. We learn, for example, that the five "Revenge" battleships roll rather badly at times, that the "Queen Elizabeths" represent the "finest group of fighting ships afloat," and the two "Renowns" are typical war-time productions—"hastily conceived, hurriedly built, and radical departures from our recognised line of development." It is, however, reassuring to hear that subsequent modifications have enhanced the fighting value of these two battle-cruisers. The units of every type in the Fleet are listed and classified with that meticulous care for which Dr. Parkes has a well-deserved reputation. Where one class has been developed out of a preceding design, he draws attention to the often subtle points of difference and explains the reason for each successive improvement. Though careful to observe the official embargo of secrecy laid upon all new construction, he is yet able to throw some welcome light on the latest designs. There is a striking sketch of the Nelson as she will appear when completed, though it is obviously in the nature of an intelligent anticipation which may be belied when the ship is at length exposed to the vulgar gaze. The sketch itself closely resembles one that appeared in *Brassey* for 1923, illustrating a design suggested by Sir George Thurston to meet the requirements of a "Washington Conference" capital ship. Quite possibly, however, both drawings do interpret more or less accurately the salient features of the new battleships. As pictured, the ships have their three triple 16in. turrets placed forward, the second turret being super-posed. The arrangement enables six guns to be discharged ahead, and all nine on the beam, but stern fire is eliminated. If this system has really been adopted it will probably lead to a controversy, for while attack is the traditional *rôle* of British battleships, occasions may arise—as they did in the Jutland action—when the enemy is coming up astern, and it would be a serious matter if the heaviest guns of the Fleet could not be brought to bear on the target. Apart from this drawback, the concentration of main armament in the forward part of the ship simplifies both the armour problem and the laying out of machinery spaces. In the "Nelson" class, it appears, the machinery and boilers are situated well aft, all uptakes leading into a single large funnel which rises not far from the stern. Another novelty is the provision of a steel tower instead of a tripod foremast. The secondary armament of twelve 6in. guns is disposed in twin turrets on the beam, three on each side, and there will be in addition numerous smaller A.A. guns. In the case of these ships utility has been purchased at the price of beauty, for their appearance, though very suggestive of maximum fighting power, is unpleasing and bizarre. Both are to go afloat during the year, and it is to be hoped that the naval authorities will then release such particulars of the class as were formerly given out as soon as a warship had been launched. Considering that some 12 million sterling are to be locked up in these two ships, and that no other Power is at liberty to lay down a corresponding vessel for years to come, the public may reasonably expect to be told something about the design. If it evokes criticism by recognised experts, so much the better, for the pre-eminence of British naval architecture was never more marked than in the days of Reed, Barnaby, and White, when new designs were freely ventilated and discussed at public gatherings.

It has been for some time past an open secret that the cruiser-minelayer Adventure, which was launched at Devonport a year ago, is to have a combination of steam turbine and Diesel machinery, the former for high speeds and the latter for cruising purposes. Dr. Parkes supplies an excellent drawing of this ship, which bids fair to become historic from the engineering point of view. No details of her machinery equipment are available as yet. She bears a superficial likeness to the "Raleigh" class, except that she is flush-decked and the armament is considerably lighter. The mines, of which a large number is to be carried, will be dropped through ports cut in the square stern. She is the first British surface ship to be built expressly for mine-laying, and as such belongs to the not very numerous family of which the earlier members were the Russian Amur and Yenesei, and the German Nautilus, Albatross, Brummer and Bremse. A certain school of naval thought holds that mining tactics have been rendered obsolete by the invention of the paravane, but we believe the Admiralty shows wisdom in continuing to devote attention to this subject and in building an experimental ship to embody the experience of mine warfare of which the late struggle was so fruitful.

The tabulation of our dwindling but rather mixed flotillas of destroyers and submarines takes up a considerable part of the space in the book. No mention is made of the new destroyers Amazon and Ambuscade now being built, nor is much information to hand respecting the latest submarines. There is, however, a note to the effect that the four guns mounted *en barbette* in Submarine X. 1 are not of the 5.5in. calibre which has been mentioned in unofficial references to the vessel. Besides the more remarkable ships to which we have alluded, the author has much of interest to tell us about familiar types in the Navy of to-day. He has produced a most fascinating little book, which, thanks to the enterprise of the publishers, may be obtained at a price within the reach of everyone.

New Destroyers for Swedish Navy.

THE Swedish Government, in accordance with a programme adopted last year, recently placed orders for the construction of two destroyers, to be named Nils Ehrenskold and O. H. Nordenskjöld. We understand that these vessels have now been laid down, the first by the Götaverken, at Gothenburg, and the second by the Kockums mek. Verkstad, at Malmö, for delivery in thirty and thirty-two months respectively. The estimated cost is 7,150,000 kronor per ship. The new destroyers are much larger than any previously built for Sweden, or, in fact, for any other Scandinavian Power. They are almost twice as heavy as the Wrangel and the Wachtmeister, the largest Swedish destroyers at present in service, which were launched in 1917. The following are the leading particulars of the new design:—Length overall, 299ft. 10in.; length between perpendiculars, 293ft. 3¾in.; breadth, 29ft. 1¾in.; normal displacement, 974 tons (metric); distance between frames, 21.65in.; turbines with reduction gearing and oil-burning boilers, probably of Yarrow type, are to be installed; the machinery is specified to develop 24,000 shaft horse-power for a speed of 35 knots. With 150 tons of oil fuel on board, the vessels will have an endurance of 600 sea miles at the full speed of 35 knots, and of 1600 sea miles at a speed of 20 knots.



THE SWEDISH DESTROYERS NILS EHRENSKÖLD AND O.H. NORDENSKJÖLD

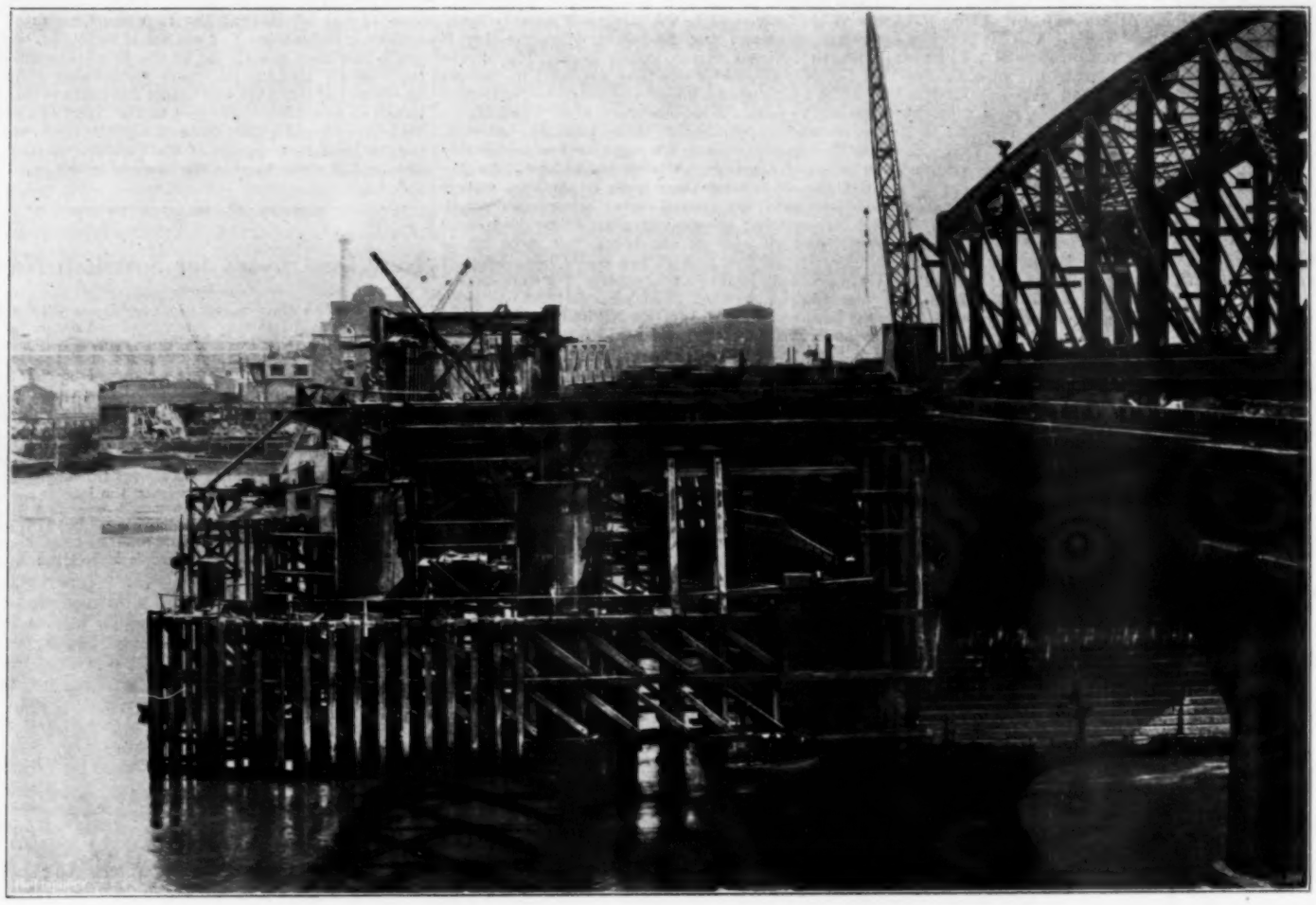
The appearance of the class, together with the disposition of armament and deck fittings, is shown in the diagrams we reproduce. Each vessel is to be armed with three 4.7in. guns, on mountings which give a sufficiently high angle of elevation to enable the guns to be used, under favourable circumstances, as anti-aircraft pieces, as well as against surface targets. There are also two 40 mm. (1.575in.) pom-poms for use against aircraft. The torpedo armament consists of two triple tubes for discharging 20.87in. torpedoes. It is of interest to note that the British system has been adopted in the grouping of the tubes, of which the centre one is placed above and between the other two. The vessels have, indeed, a distinctly British appearance, and but that they are flush-decked, would resemble our Admiralty "S" type boats. The hull has a pronounced sheer and the forecastle is cambered.

Excepting these destroyers and one submarine begun in 1922, no new construction is in hand for the Swedish Navy, a more ambitious building programme having been shelved in consequence of a Cabinet crisis last autumn. The extremely high cost of modern naval shipbuilding renders it a matter of increasing difficulty for the minor maritime Powers to replace their obsolete vessels with others of equivalent tonnage and fighting value; but in the Ehrenskold and the Nordenskjöld the Swedish Navy will have two destroyers of a type that compares favourably in every respect with all but the latest torpedo craft in service elsewhere.

A LIBRARY is being organised in connection with the Institution of Chemical Engineers, and will be open daily for use of members from July 1st. A special room has been equipped for the purpose in the offices of the Institution at Abbey House, Westminster, S.W. 1. It is the intention to publish every two months a "Bulletin" which will give a list of additions to the library, and a list of new books on chemical engineering subjects.

ERECTION OF WATERLOO TEMPORARY BRIDGE

SIR WILLIAM ARROL AND CO., LIMITED, GLASGOW, ENGINEERS



Waterloo Temporary Bridge.

On Tuesday at 3.30 a.m. the work was begun of launching the 280ft. navigation span of the temporary Waterloo Bridge across the Thames. This span was erected on the roadway of Rennie's celebrated structure, and was moved sideways across a space of 93ft. horizontally on trolleys, running on rails which extended from the side of the old bridge to the piers of the new. The movement was effected by means of hand-operated winches and was completed at 12 noon. On Wednesday preparations were begun for lowering the span a distance of about 12ft. to bring it into alignment with the two 140ft. spans erected on the north side of the river, and the five spans of a similar length on the south side. The lowering operations were accomplished by means of four 200-ton screw jacks and an arrangement of crossheads which permitted the span to be lowered in steps of 7½in. alternately at one end and the other. In the engraving on this page we reproduce a view taken on the day before the launching operations were begun. This view shows the cylindrical steel piers for the southern end of the navigation span, together with the girders for the runway extending from the old to the new bridge. To the right, the navigation span is seen in the position in which it was erected on the old bridge. In next week's issue we shall publish a detailed description of the bridge and the launching operations.

FARADAY AS A CHEMIST.

In his discourse at the Royal Institution on "Faraday as a Chemist," which was delivered on Friday, 12th inst., Sir William Pope recalled that Michael Faraday was born in 1791 into a working-class family, and became an errand boy in his thirteenth year. He thus received but a rudimentary elementary education, but he overcame that disadvantage by assiduous private study, and was appointed assistant in the laboratory of the Royal Institution in 1813 on the recommendation of Sir Humphry Davy. He succeeded Davy as the Professor of Chemistry in 1827. Faraday devoted his life to experimental research in chemistry and physics in the Institution, and at his death in 1867, his loss was morned by practically every learned society in Europe as that of one of the greatest natural philosophers of the early part of the nineteenth century.

Faraday made his advent as a scientific investigator at a moment when striking advances in chemistry were imminent, and were indeed to be foreseen. The work of his immediate predecessors, Lavoisier, Davy, Dalton, Berselius and Avogadro, had made of chemistry an exact science, and such a genius as Faraday's was needed for the development of experimental methods. He worked on a variety of chemical subjects for several years, and on June 16th, 1825, laid before the Royal Society the results of his study of the liquid deposited from compressed oil gas, in the course of which he had discovered the compound of carbon and hydrogen now known as benzene.

The hydrocarbon benzene, which is now separated in large quantities from coal tar, is the parent substance from which all the synthetic or coal tar dyes are derived. At this centenary of the discovery of benzene we celebrate the anniversary of the initiation of a large branch of organic chemistry, which in later years became of great scientific importance, and which, in addition, became the foundation of the several vast industries dependent on the utilisation of the components of coal tar. Among these latter are to be numbered not only the manufacture of coal-tar dyes, but also important sections of the pharmaceutical, photographic and petroleum industries.

Faraday was the first to make a minute and quantitative study of the chemical changes which result from electrical actions. In this connection, he discovered certain electrochemical laws which are of profound chemical significance, and which still retain their importance in connection with chemical theory. He carried out the first systematic study of the manufacture of glass for optical instruments; he made the alloys of iron with chromium and nickel and they, as nickel-steel and chromium-steel, have become important in connection with the manufacture of armour-plating and stainless cutlery. He studied the transparency of very thin sheets of gold, and showed that the ruby colour of glass which has been fused with addition of small quantities of a gold salt, was due to the dissemination of minutely small particles of metallic gold throughout the mass; and he connected with that phenomenon the red colour of the so-called colloidal solutions of metallic gold in water.

Particulars of the power plants used in Danish agriculture are given in a recently issued report. It was estimated that permanent power plants, other than windmills, were owned by 86 per cent. of the farms covering between 120 and 240 hectares. Of the farms above that acreage practically all had their own plant, either electro-motors, petroleum, or other internal combustion engines, or steam power plant. Steam, it may be remarked, was to be found only in the case of the largest farms. The census comprised about 200,000 farms of over one tonder of land (1.36 acre), the returns from some 7000, mainly of the smaller categories, being inadequate. Of the remaining 193,000 farms, it appeared that there were in use about 39,600 electrical plants; about 14,800 internal combustion engines, and about 700 steam power plants. Furthermore, about 6100 farms had wind power plants, apart from wind pumping and draining plants. In a number of cases, particularly as regards the larger farms, plants of more than one kind were in use on the same farm.

The Icebreaker Krisjanis Valdemars.

The icebreaker Krisjanis Valdemars, which has been built by William Beardmore and Co., Ltd., at Dalmuir, for the Marine Department of the Government of Latvia, was successfully launched on the 9th inst., the launching ceremony being performed by Madam Vesmans, wife of his Excellency the Latvian Minister.

The vessel is intended for ice-breaking purposes in the Gulf of Riga, so as to ensure that the port of Riga may be accessible to shipping at all seasons of the year. Her principal dimensions are:—Length on the water line, 185ft.; breadth on the water line, 54ft.; depth moulded to upper deck, 28ft. 6in.; normal draught, 22ft.; normal displacement, about 2800 tons.

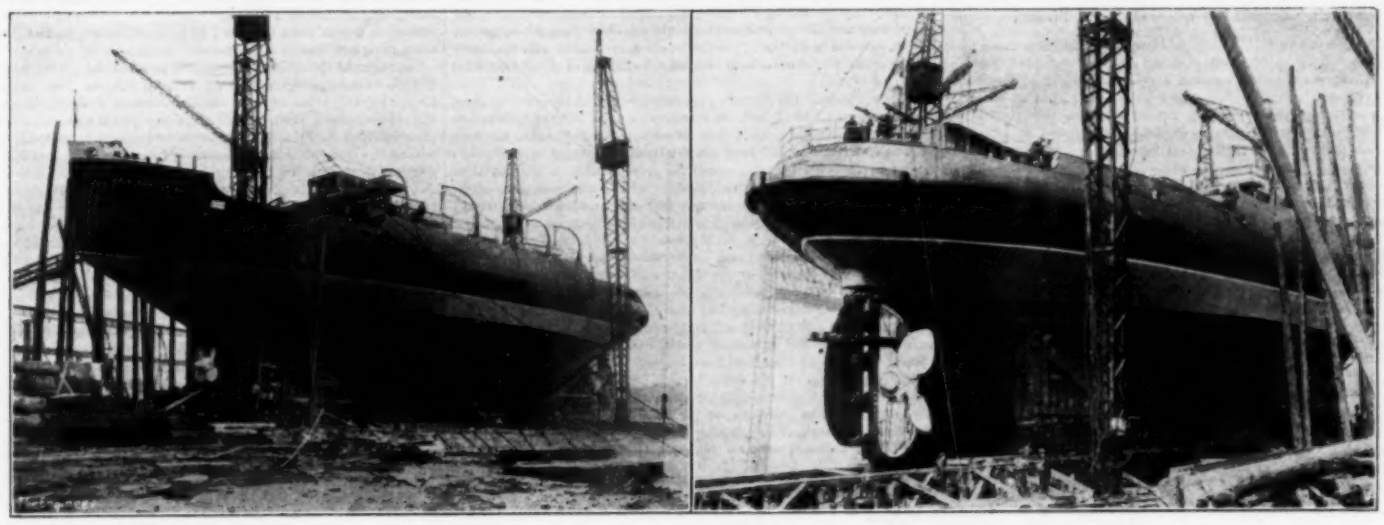
The vessel has a specially designed stem, with considerable rake under the water line, and a stern of cruiser type, both stem and stern post being of cast steel reinforced as necessary for ice-breaking purposes. The framing, which is on the deep-frame principle, is exceptionally strong, the spacing of the frames being 18in. apart amidships, and only 12in. apart at the ends. The shell plating is also much in excess of the usual requirements of the Bureau Veritas, with which the vessel is to be specially classed, while the ice belt from about 6ft. above the water line to about 9ft. below is 1in. in thickness, both fore and aft, the end plating down to the keel line being practically of the same thickness. In addition to heavy closely spaced water-tight bulkheads, there are, on each side of the vessel for about three-quarters of the length amidships, longitudinal water-tight bulkheads, forming coal bunkers and water ballast tanks, and the whole system of subdivision is so arranged as to enable the vessel to obtain the special mark assigned by the Bureau Veritas to vessels which are capable of remaining afloat with any two compartments open to the sea. By rapidly transferring water from the end tanks forward to the end tanks aft, or *vice versâ*, the vessel may be quickly trimmed either way, and, similarly, by transferring water from tanks on one side of the vessel to tanks on the other side, she may be quickly heeled, so that it may be possible to free her in the event of her being locked in ice. Special arrangements are made for taking a vessel in tow, a recess being provided in the stern so that the stem of the following vessel may be drawn into it, and held in that position by means of a large towing winch of exceptionally powerful type, which will be fitted on top of the aft deck-house.

The vessel is furnished with electric light throughout, the generating plant consisting of two engines and dynamos each of 20 kilowatts and 120 volts. Wireless telegraphy apparatus, two flood light projectors, and a powerful searchlight projector are also installed on board. There is also an electrically driven submersible salvage pump, of about 200 tons per hour capacity, which can be transferred to a vessel in tow or alongside, so as to render assistance in case of damage.

With regard to the accommodation, there are two large state rooms and a saloon for directors, the remaining accommodation being ample and roomy, while the arrange-

LATVIAN ICEBREAKER KRISJANIS VALDEMARS

WILLIAM BEARDMORE AND CO., LIMITED, DALMUIR, BUILDERS AND ENGINEERS



ments for heating and ventilating and for insulating the sides of the ship, bulkheads and decks in way of all living quarters, are designed to ensure the maximum amount of comfort to the officers and crew, compatible with the most trying climatic conditions, which may be encountered on the service for which the vessel is intended.

There are two sets of triple-expansion engines, one for driving the after propeller, having cylinders 26½in. by 42½in. by 69in. by 43½in. stroke, and one for the forward propeller, having cylinders 16½in. by 26½in. by 43½in. by 20in. stroke. Steam is supplied by four single-ended coal-burning boilers, each 15ft. 9in. diameter and 11ft. 10in. long, worked under Howden's system of forced draught, smoke-box superheaters of the Sugden type being also fitted.

The machinery is of a specially massive character, in view of the extremely heavy stresses which may be brought to bear upon it in service, the shafting and propellers being of special nickel steel. The principal functions of the after engine are to propel and to manœuvre the vessel, and it is capable of developing about 4000 indicated horse-power for those purposes. The forward engine is used to drive the forward propeller, and to assist in the propulsion of the vessel, and this engine is capable of developing about 1500 indicated horse-power. The forward propeller is, however, primarily fitted to assist in ice-breaking, so that when the stem of the vessel is on the ice the propeller may act as a suction pump, sucking the water away from under the ice, and thus withdrawing its support, so that the weight of the vessel, together with that of the water ballast transferred from tanks at the after end of the vessel to the tanks at the forward end, may break down the ice and enable the vessel to forge ahead and thus clear a passage.

The auxiliary machinery includes Weir's independent air pumps, circulating pumps and forced draught fans by Messrs. Paul, of Dumbarton, feed pumps by Mumford, and two of Watson's large centrifugal pumps, each capable of discharging about 900 tons per hour capacity against a head of about 50ft. The latter are to be used for transferring a large quantity of water ballast from forward to after tanks, or *vice versâ*, and from tanks on one side of the ship to tanks on the other side, in about 10 min.

The accompanying engravings show bow and stern views of the vessel just prior to her launch.

South African Engineering Notes.

Union Steel Industry.

MUCH light has been thrown upon the position of the iron and steel industry in the Union of South Africa, and its prospects of future development, by the evidence given by witnesses examined by the Select Committee on Railways and Harbours on the proposed extension of the agreement of 1920 between the Minister of Railways and Harbours and the Pretoria Ironworks, Ltd., now the South African Iron and Steel Corporation, Ltd. Mr. J. K. Easton, a director of the Union Steel Corporation, stated that they wanted fresh capital to increase the Newcastle works and also to increase the steel capacity of the Union Steel Corporation; that £500,000 was to be spent at Newcastle and Vereeniging; then, later on, when they got the Newcastle and Vereeniging works running to full capacity, it was proposed to raise further debentures to put up plant in Pretoria. The position of the Newcastle concern now was that they were going ahead. There was enough ore in sight to last about twenty years on an annual consumption of 100,000 tons. The company would get a larger market by producing cheap pig iron. There were no foundries at present on the Rand that could produce machinery, because the cost was excessive and it was cheaper to import the finished article. Mr. R. W. Allen, secretary of the Iron and Steel Corporation, described the origin and growth of the Pretoria concern, and related the first efforts of the Corporation to raise additional capital in Europe, which failed. Since then Mr. Delfos—managing director—had been in touch with some German and Belgian interests, which were said to be favourably impressed with the reports, and those of their own experts who had come out last year. It may be added as regards the Union Steel Corporation—not to be confounded with the Iron and Steel Corporation with which Mr. Delfos is concerned—that much activity now prevails there. The acquirement of the iron ore bearing properties and the blast-furnace and accessory equipment of the Newcastle Iron and Steel Works, the transfer of which to the Vereeniging enterprise is now completed, is an integral and essential factor in the development of the industry. It is now officially stated that the Newcastle blast-furnace plant will start in August. The initial capacity will be 5000 tons per month, and when the blast-furnace is blown in a new and most important epoch in the history of South Africa's iron and steel industry will be inaugurated. In keeping with the plan, the work of enlarging the plant at Vereeniging is now in progress, and the essential features of this operation are:—(1) Increasing the furnace capacity by the installation of a new 30-ton Siemens furnace, which will come into commission in about six months' time; (2) installation of a Tropenas process equipment. The plant of the Vereeniging works consists of three Siemens open-hearth basic furnaces of 15, 20 and 25 tons capacity respectively—with the usual gas producers and one 3½-ton Héroult electric furnace. A new 30-ton furnace is now being erected. The rolling mills consist of one 12in., one 15in. merchant bar mill and 22in. cogging and finishing mills, with the necessary reheating furnaces, mechanical live roller conveyors, hot banks, loading banks, modern hot saws and straightening machines, and roll-turning lathes. The foundry is equipped for the production of both iron and steel castings, with drying stoves and annealing furnaces. The works buildings are served by three electric overhead travelling cranes and extensive sidings. The products cover a very side range of sections, rounds, squares, flats, angles, channels weighing from 0.375 lb. per foot to 30.6 lb. per foot. Tube mill bars in hard steel are manufactured for the mines, as well as rails from 16 lb. to 45 lb. per yard. Steel castings up to from 10 to 15 tons are produced, and so are shoes and dies, both cast steel and forged steel, for use in mine batteries. The Tropenas plant being installed consists of one 2-ton converter with its attendant cupola and blowing engine. The converter is fed from a separate cupola, which is situated alongside, while the necessary air is supplied by means of the blowing engine. The converter is worked by one or two rows of tuyeres, which supply the necesary air for oxidation of metalloids at a pressure of 3 lb. to 4 lb. per square inch. Four grades of steel are made as follows:—(1) Magnet steel for electrical purposes—carbon, .09; (2) mild steel—carbon, .20; (3) general castings, skip wheels, &c.—carbon, .30; (4) gear wheels, die blocks and harder castings—carbon, .40. During the nearly twelve years that the Union Steel Corporation has been in active operation, it has handled and turned out no less than 200,000 tons of steel, and has proved itself a factor of first-rate importance in the industrial life of South Africa. During the first years of operations the number of employees was 84 white and 166 natives. During the past year the number of whites employed was 220 and natives 566. The average monthly output for the first two years did not exceed 325 tons. The average monthly output for 1923 was over 1500 tons, and the present rate of output is about 2000 tons per month, which it is intended to increase to 4000 tons, of which 30 per cent. will be "pig." The Corporation has also acquired the very large and important iron ore beds in the Kromdraai district.

A Union Railway Deal.

The South African Union Railways are to take over the New Cape Central Railway, running from Mossel Bay to Worcester, a distance of 209 miles. An agreement has been come to between the New Cape Central Railway Company and the Union Government under which the Government acquires the line, rolling stock, &c., for the sum of £1,100,000. Very substantial reductions in rates will, it is anticipated, accrue to traders as a result.

Bwana McKubwa Copper Mine.

The latest report with regard to the big copper mine, Bwana McKubwa, Northern Rhodesia, states the ore reserves at the end of last year were 7,568,365 tons, averaging 3.9 per cent. copper. Owing to the nature of the ore, it is being mined by open cut methods using steam shovels, and the working costs are very low. The plant about to be put into operation will treat 1000 tons of ore per day, which it is intended to increase later to 2000 tons, and ultimately to 3000 tons per day. Large as are the figures in the case of the Bwana McKubwa, they become almost insignificant when compared with those of the great Congo copper producer, the Union Minière du Haute Katanga, which has ore reserves amounting to 68,300,000 tons, containing 4,575,000 tons of copper, representing a gross aggregate value of little short of £300,000,000. Unquestionably the centre of gravity in copper production has shifted to the Belgian Congo, and the upper part of Northern Rhodesia and the Union Minière may be said to dominate the whole position.

The Gold Basis.

The Union Government has returned to a gold basis, but sovereigns will not be immediately available in large quantities, as the £11,000,000 held by the Treasury has to be sent to the Mint at Pretoria to be sorted, and, where necessary, recoined. It is stated that 20 per cent. of the coins are light. The British Government bears the expense of recoining.

Mining Efficiency.

Owing to the great improvement in the efficiency of the workmen and the scientific study of methods of mining and metallurgy, and particularly in the evolution of new types of jackhammers and the treatment of drill steel, reductions have been effected in the working costs of such of the Rand gold mines as have equipped themselves with these latest devices, which have, to a great extent, compensated them for the loss of the gold premium. As an example of the saving, it may be pointed out that in machine stopes the tonnage obtained per native per shift in the Central Mining the Rand Mines Group was, during the first half of 1923, 4.79 tons. In the latter half of that year it rose to 5.43; in the first half of 1924 to 6.37 and during the last six months of 1924 to 7.32. In machine developing the footage per native per shift has risen, during the same period, from .45 to .55. That this is due to general improvement in machines and their equipment is shown by the fact that no similar increase is shown in hand work, either in stopes or development ends, the figures for such work being absolutely the same at the end of the period as they were at the beginning. The substitution of improved hammer drills for hand drilling, as far as it has taken place, has resulted in a saving of not less than 5000 natives, and, notwithstanding this considerable saving in native labour, a greater tonnage has been handled and a much increased development footage effected. The introduction of jackhammers has also been responsible for a great economy in explosives. While in the middle of 1922 well over 50 lb. of nitro-glycerine was required to break 100 tons of rock, in December, 1924, the same work was effected with the expenditure of less than 38 lb.

Another Gold Mine.

It is rumoured in well-informed circles that the tender submitted by Sir J. B. Robinson for the Geduld East area of 2641 claims has been found acceptable by Government. If this prove to be correct, it will, of course, mean a great deal for the mercantile community of the Rand, as the opening up of such a large mining area will mean the early expenditure of capital sums for development, and the employment of much white labour. The Government Mining Department estimates that to sink, equip and bring the mine to the production stage will require £1,850,000.

OPERATIONS on the Karanpura coalfield, India, began with the opening of the Argada Colliery in the first week of May. This is the first colliery that exclusively belongs to the Bengal Nagpur Railway. It is situated between Hazaribagh and Ranchi, and forms the gateway of the Karanpura coalfield, lying on the eastern flank of an extensive area of virgin coal, which will probably be worked by increasing numbers of collieries as the railway advances across the field. The first sod for the colliery shaft was only cut last year, and the progress made is remarkable. Offices, power-house, pumping station and hospital and staff bungalows have been completed, and the erection of the power plant is progressing rapidly.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

THE EXCHANGE LOCOMOTIVE TESTS.

SIR,—The relative difficulties of the gradients on our main lines can be tested by calculation, making use of a standard curve of tractive force operating against a standard curve of resistance on level road. With such curves, impartially applied to given routes, a comparison can be made between the theoretical schedule, and that which is actually attempted in practice. One has to recognise that speed restrictions, permanent way repairs, and other adverse conditions must be allowed for in framing a time-table; so that it is a usual practice to allow a margin of time over some easy portion of the line, in order that detentions may be made up. Such a margin would have to be added to the time given by the theoretical schedule in making the comparison referred to, although regular service speed restrictions may be included in the theoretical speed graph itself.

Early this year I made certain calculations of the kind and applied them to the routes which have been the scene of the recent exchange tests. I assumed a train of 500 tons weight behind the tender of an engine of 120 tons weight, and estimated the values for the curves of tractive force and of resistance on the level; these being then applied to obtain a speed graph from Paddington to Exeter. The schedule of times of passing intermediate stations differed by only 1 min. as far as Taunton, and by 2 min. at Exeter, from those which are actually set for the non-stop trains on the route; and my 500-ton train did not slip any coaches at Westbury or Taunton. My phantom engine was shown to be less powerful than the G.W.R. engines actually are in practice on their own line; but otherwise confidence was established in the estimated relation between tractive force and resistance. My engine exerts 1700 indicated horse-power at 65 miles an hour on the level. I next applied the phantom train to the route between King's Cross and Doncaster. No stop was made, but a slowing took place to 15 miles an hour through Peterborough Station. The speed graph resulting from the calculations is that shown by dotted lines in the diagrams I send you. It may fairly be taken to show what the G.W.R. engines ought to be able to do with a 500-ton train, if worked as they are on their own line, and if using their own Welsh coal. I may say that some of the principal passing times derived from this graph were published at the end of March in the April issue of the *Railway Magazine*.

I was fortunate enough to be a passenger by the 1.30 p.m. train from King's Cross to Doncaster on April 30th, and timed the train with a stop watch in such manner as to get the speed graph shown by the full line in the diagrams. The ascents to Finsbury Park and to Potters Bar are astonishing exhibitions of climbing power in view of the times usually taken by L.N.E.R. trains when they exceed 400 tons in weight. After leaving Peterborough, a similar exhibition was given in the ascent to Stoke Box; the speed between Essendine and the summit being 51½ miles an hour. There was a pronounced slowing between St. Neots and Huntingdon, possibly due to signals, but Peterborough was reached more than 3 min. before time. From Stoke Box to Doncaster the "margin time" allowed permits of easy running on the down gradients, and should help to account for some of the reduction in fuel consumption, which is shown on the Doncaster trips, as compared with those which terminated at Grantham on the alternate days. Doncaster was reached 2 min. early.

I may remark that in going south on the previous day, I travelled by the 3.7 p.m. train from Grantham behind the same engine, which, with a load of about 485 tons, including passengers and baggage, ran the 60 miles from just before Yaxley up to Potters Bar in exactly 60 min., and the 44 mile ascent to Stevenage in 43 min. 50 sec. The gradients are shown on the diagram. It is evident that the "Castle" class of engine can do more than make the short sharp climbs referred to in your Editorial of June 5th.

Since reading the letters of correspondents in your current issue—June 12th—I find, on reference to the *Railway Magazine* of December, 1924, that one of the "Castle" class engines brought a train of 340 tons weight from Westbury up to Savernake in 24 min. 53 sec., which is considerably less than that claimed for L.N.E.R. engine No. 4474 with 5 tons greater weight. As to passing over the summit at 64½ miles an hour, one would like to have exact details of the distance, position and timing upon which the claim is made, seeing that to accelerate up the last gradient to the summit might require over 3000 indicated horse-power! What was the speed at Pewsey?

Your editorial comments upon the suitability of engine to road are well illustrated by the tests, so far as the working of the "Pacific" on the G.W.R. is concerned. The large tender, being a necessity for the L.N.E.R. work, owing to wider spacing of track troughs in the North and over the border, must have been a handicap on the steep banks, and perhaps some reasonable part of the tare weight of the tender might be allowed as weight hauled to compensate for this disadvantage. It seems to be recognised that keeping time between Paddington and Plymouth was not an easy task for the driver and fireman of No. 4474, and they deserve praise for their pluck and skill, and for the manner in which they steadily reduced the coal consumption as the tests proceeded; but the handicap of inferior coal must be credited to Pendennis Castle on the other line. General surprise has been expressed that the small grate and heating surface of this engine were able to provide enough steam from that fuel. For considerable lengths of time the steam demand must have been 34,000 lb. per hour, and even more for short periods. One would hardly expect economy of fuel to accompany the production of so much steam from a grate of 30 square feet area. The boiler must be of unusually high efficiency for its size, and throws some doubt upon the utility of an empirical formula for arriving at the power rating of a locomotive. In regard to shape of fire-box, it seems to me that it would be worth while to test the broad type of grate with inward slope of fire-box sides towards the top against the narrow type of grate with wide top to fire-box. There must be some most efficient period of time, during which a particle of water is kept in contact with its heating surface before it leaves to ascend to the steam space. The G.W.R. fire-box tends to prolong the contact, so that when a particle leaves it has reached the steam condition required by means of one contact only. The other fire-box may liberate particles too soon, so that they have to return for another heat. Perhaps your readers would like to discuss this. Have any really authoritative experiments dealt with the point, without being complicated by extraneous considerations?

F. H. ALEXANDER.

Newcastle-on-Tyne, June 15th.

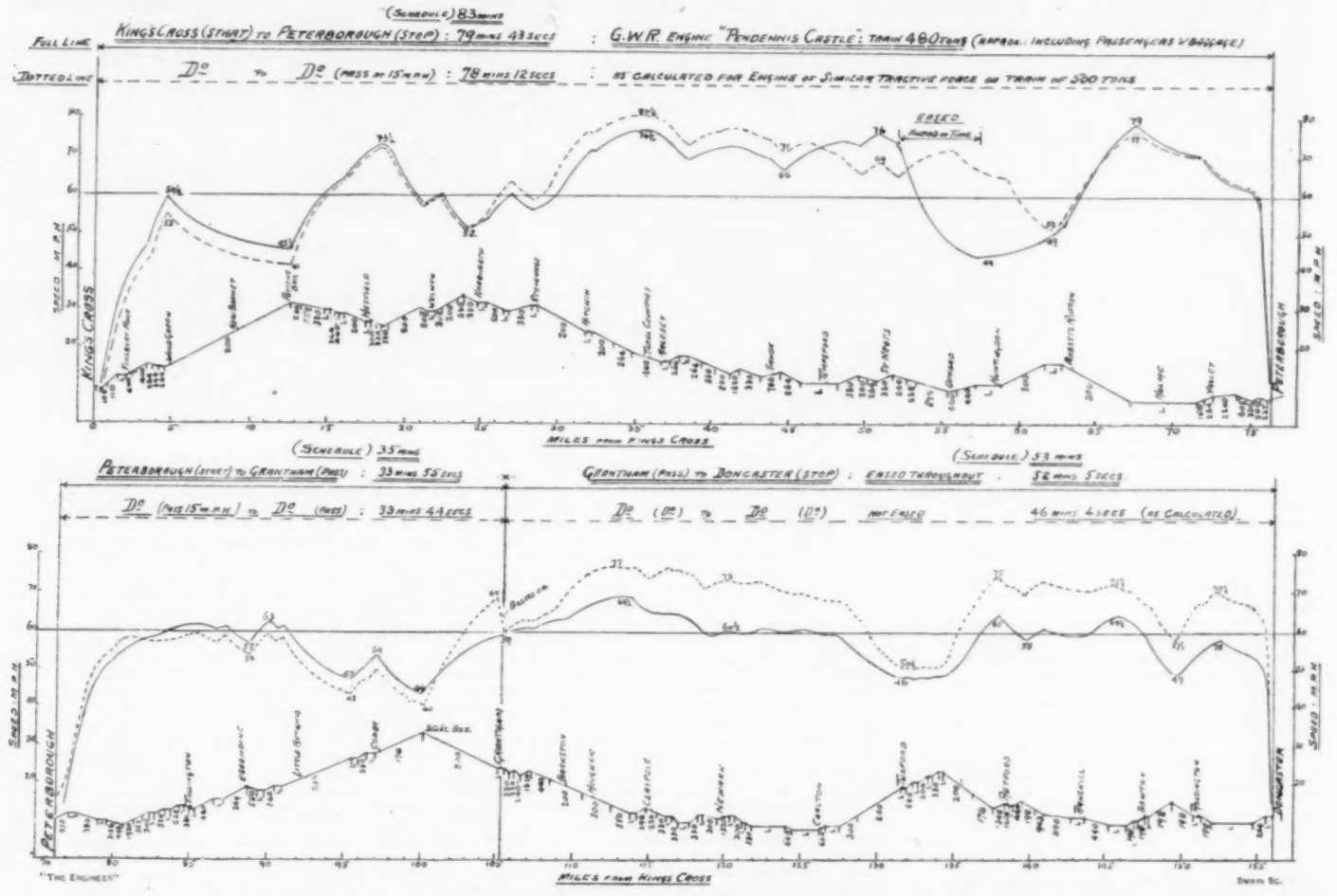
SIR,—The reason of the difference in the exhaust beats of the G.W.R. and L. and N.E.R. engines is that the former has four exhaust beats to six of the latter every revolution of the driving wheels, this extra blast improving the steaming of the L. and N.E. boiler.

The G.W.R. have been renowned for many years for the uniformity and regularity of the exhaust beats of their engines. Their method of setting the slide valves is almost a secret, being only known to a few, and the favoured ones at the Wolverhampton depôt used to claim to go one better, in the process, than their colleagues at Swindon.

As regards the present Swindon practice of giving the slide valves increased lap and long travel, this is "an old man's idea," having been adopted by Mr. Sinclair and Mr. Connor on the Caledonian Railway about sixty years ago, who used to give as much as 1¼in. lap and increased travel to suit, this facilitating the free exhaust of the steam from the cylinders when the engines were running at a high speed.

The extra 45 lb. in boiler pressure of the G.W.R. engine makes itself felt to great advantage, and I may say I asked a G.W.R. express driver yesterday "What would happen if the boiler pressure dropped from 225 lb. to 180 lb. on the journey?" He replied, "If we had our ordinary load on we should be finished as regards keeping time." If this extra 45 lb. pressure is obtained at the expense of only a few degrees of heat from the fire, then let us have more at the same price, and I think I am correct in stating that it is in this direction that engineers are now looking in endeavouring to save the steam engine from its threatened extinction. The G.W.R. boiler, although much smaller than that of the L. and N.E.R., has at least proved itself equal in steam-raising ability, and, in my opinion, the G.W.R. fire-box is the better of the two. A portion of the wide fire-grate of the L. and N.E.R. boiler overhanging the framing of the engine, the grate is handicapped by not having a draught of uniform intensity all over it, and I should say it is weaker in the wings and, of course, stronger along the middle. The sloping sides of the fire-box are better than vertical ones for evaporation, but prevent the free and efficient combustion of the gases, since a portion of them comes into contact with the comparatively cold sloping sides of the fire-box as they rise from the fire, thus lowering their temperature. The contraction of the volume of the upper part of the fire-box is, in my opinion, also detrimental to efficient combustion, since provision should be made for the expansion of the gases as they rise and expand under complete combustion. The upper part of the fire-box of the G.W.R. boiler is increased in volume per unit of depth, this also giving the fire-box a much increased horizontal heating surface—two excellent features, also the curved sides of the fire-box, in my opinion, relieve somewhat the strains set up by expansion and contraction on account of their flexibility, and although I know nothing about these boilers and their fire-boxes, also any "wear and tear" troubles attached to them, I should say that the G.W.R. boiler gives no unusual trouble in spite of the higher pressure carried. The increased volume and shape of the upper part of the G.W.R. fire-box gives the gases a chance to deploy before leaving the fire-box, and the flame spreads, taking a fan-shape form in sweeping along the top of the fire-box towards the tubes. Another good feature in the design of the G.W.R. boiler is the large water space over and around the upper part of the fire-box, the most efficient part of all the heating surface.

The G.W.R. claim to have effected great improvements in the design of their slide valves, &c., and I am interested in this particular question, since, about fifteen months ago, an article on "Favourable Points in Four-cylinder Design Locomotives," written by a Swindon official and read before the Swindon Engi-


KING'S CROSS (START) TO PETERBOROUGH (STOP) : 79 MINS 43 SECS
G.W.R. ENGINE "PENDENNIS CASTLE" : TRAIN 480 TONS (APPROX. INCLUDING PASSENGERS & BAGGAGE)
DO TO DO (PASS at 15 M.P.H.) : 78 MINS 12 SECS
AS CALCULATED FOR ENGINE OF SIMILAR TRACTIVE FORCE ON TRAIN OF 500 TONS
ERSED
KING'S CROSS
PETERBOROUGH
MILES FROM KING'S CROSS
PETERBOROUGH (START) TO GRANTHAM (PASS) : 33 MINS 58 SECS
DO (PASS 15 M.P.H.) TO DO (PASS) : 33 MINS 44 SECS
GRANTHAM (PASS) TO DONCASTER (STOP) : EASED THROUGHOUT : 58 MINS 5 SECS
DO (0) TO DO (0) NOT EASED : 46 MINS 4 SECS (AS CALCULATED)
Stoke Box
Grantham
"THE ENGINEER"

SPEED GRAPHS OF TRAINS—ESTIMATED AND ACTUAL

neering Society, was published in the *G.W.R. Magazine*. In the article it stated that the "steam lap" of the slide valves of the G.W.R. had been considerably increased and the "lead" considerably decreased, and in order to show the improved efficiency brought about by the latter alteration there was shown a diagram of the crank circle with the positions of the crank when the slide valve opened to "lead" under the new and old arrangement; in the former the crank was only 7 deg. and in the latter 24 deg. from the dead centre, and the author pointed out the great reduction in the amount of the negative work on the piston by reducing the "lead." A pair of indicator diagrams taken off two of the engines was also illustrated to show the great improvement effected in the power extracted from the steam under the new conditions, but apparently not to show the negative work, as mentioned above. In order to show up the improvement more clearly one diagram was placed over the other, and on examining the diagram taken off the engine with the old design of slide valve I noticed its area was very much less than that of the other diagram, and I came to the conclusion that the volume of the steam admitted to the cylinders was not equal, having been much less in the case of the engine giving the poorer diagram, also the steam piston of the engine was passing steam, but what interested me most was the compression curves of each of the diagrams, that of the poorer diagram being by far the lowest, standing well outside and below that of the other right up to the end of the stroke, which, according to the diagrams, clearly showed that the new method of slide valve setting had the heavier back pressure, and exploded the theory put forward in the crank circle diagram.

I copied the indicator diagrams, plotted on same the position of the steam piston, when crank was 24 deg. from the dead centre, and ran up the ordinate to show the difference in the back pressure on the pistons at that point, that of the old methods of slide valve setting being much lower and continued lower from there right to the end of the stroke, pointed this out in a letter and forwarded the lot, together with a copy of a set of excellent indicator diagrams taken off the broad-gauge 8ft. single-wheel engine Great Britain when running at 55 miles per hour between Bristol and Exeter, in the year 1848, to let them see what our grandfathers could do, to the editor for publication which he refused to do on the score of insufficient space.

Streatham, S.W. 16, June 16th. WM. HY. ROBSON.

SIR,—An error of quotation unfortunately occurs on page 652, stating that "694" indicated horse-power was the all-through indicated horse-power of G.W.R. locomotive Caldicot Castle which, if opportunity occurs, I should be glad to repair by the following, from the paper by Mr. C. B. Collett, taken as read, at the World Power Conference :—

Dynamometer-train test of Locomotive Caldicot Castle, 19th and 20th March, 1924, from Swindon, *vid* Badminton, Bristol relief to Plymouth, returning *vid* Bristol relief and Box to Swindon ; 14 coaches and dynamo car to Taunton ; 11 coaches and car to Newton Abbott ; 8 coaches and car to Plymouth. On return, 8 coaches and car to Newton Abbott ; thence 14 coaches and car to Swindon.

Time of double journey	7.12 hours
Average I.H.P. per hour	975
Total I.H.P. hours	6941
Coal per I.H.P. hour, net	2.10
Total coal consumed on road, deducting fire kindlings	14,579 lb.
Coal per draw-bar H.P. hour	2.83 lb.
Mechanical efficiency, draw-bar H.P. ÷ I.H.P. .. .. =	0.74
Average draw-bar H.P. (at 975 × 0.74) =	721
Water evaporated per lb. coal	12.2 lb.
Net water consumption, deducting for injector overflow and odd leakages, per I.H.P. hour	20.9 lb.
Per draw-bar H.P. hour	28.1 lb.
Indicated thermal efficiency (I.H.P. ÷ heat in coal) .. .. =	8.22 p.c.
B.Th.U. per lb. coal	14,780
Coal per 1000 ton-miles run	101 lb.
Average power output per ton of locomotive, 975 ÷ 80 .. .. =	12.2 I.H.P.

Tests, April–May, 1925.

Coal per 1000 ton-miles, lowest figures only—

Caldicot Castle, April 28th, Paddington to Exeter ..	106.8 lb.
Pendennis Castle, April 30th, King's Cross to Doncaster	107.6 lb.

Average train loads on G.W.R.—

G.W.R. engine, ton-miles 501,707 ÷ 1356 miles =	370 tons.
G.N.R. engine, ton-miles 495,919 ÷ 1356 miles =	366 tons.

The G.W.R. engine and tender, about 120 tons + 370 tons, average gross train load = 490 tons × 1356 miles, ran 664,440 gross ton-miles in consuming 56,896 lb. coal, or a little over 85 lb. per 1000 tons gross miles, which shows that although the G.W.R. latest engines may be the most economical of single-expansion locomotives in England, there are yet more economical engines on the Midland Railway :—

*Carlisle, *vid* Aisgill summit, to Leeds, express with dynamometer, October 27th, 1902 (saturated), 85.6 lb. per 1000 ton-miles.

†Average, ten trains, Leeds–London–Leeds, October, 1913 (saturated), 91.6 lb. per 1000 ton-miles.

†Average, ten trains, Leeds–London–Leeds, all three-cylinder comps. (superheated), 67.9 lb. per 1000 ton-miles.

June 15th. C. R. K.

SIR,—Referring to your Leader, I suggest that some very definite conclusions can be drawn from the fact that the G.W.R. "Castle" engine of the 4–6–0 type proved itself capable of the work performed—at least on these particular occasions—by the L.N.E.R. "Pacific" type, with, roughly speaking, the same nominal cylinder horse-power, but with a boiler of, apparently, 50 per cent. greater capacity, and working on its own road.

That the L.N.E.R. engine should have accomplished the tasks set to it on the G.W.R. line may, perhaps, prove very little ; but for the 4–6–0 G.W.R. engine to accomplish the same work as the "Pacific," while burning less of a fuel inferior to its wont, surely proves a very great deal. It would have been a remarkable performance even on the same fuel consumption.

It shows, for instance, that for the given services the longer and heavier engine is unnecessary. You and others have pointed out that the "Pacific" type is handicapped in its work on the G.W.R. by the fact of its being too long and too heavy for that road. Now, while it is clearly not, in this sense, too long or heavy for the easier road for which it was designed, the fact still remains that its wearing effect on that road must be greater than that of a shorter and lighter engine, and this fact must be taken into consideration in any attempt to weigh the comparative merits of the two types.

We have been informed officially that the saving in coal by the G.W.R. engine on the line of its rival is to be discounted by the higher costs of boiler upkeep due to the higher pressures used, although it is quite well known to all railway engineers that there are special features in the design and construction of G.W.R. boilers which are intended to, and probably do, reduce the cost of such upkeep.

But, even if we accept some increase of boiler upkeep as inevitable, there must certainly be set against it the reduction in permanent way upkeep which results from the running of the shorter and lighter engine on the G.W.R. line.

Yet this aspect of the question seems likely to be ignored, because we seem to be in danger of inverting the standard by which a locomotive should be judged. Conversation in the past with railway directors, amateur locomotive designers, railway enthusiasts, my own children and the general public have convinced me that to them size—as measured by a huge smoke-box with a diminutive chimney—is the accepted criterion of locomotive efficiency.

This view is being taken to-day by those who, while admitting the remarkable performance of the G.W.R. engine, seem to regret that it should have done better than its larger and more imposing-looking rival. Though such a view seems to be as unsound in engineering as it would be in sport, I verily believe that if a locomotive were produced which could do the work of the "Pacific" or "Castle" engine, but with half its size, it would be almost as unpopular with the Press as with the public—indeed, Sir, not only with the popular Press—for this acceptation of size and weight as virtues has so infected our time that a writer in a technical journal of repute, not many years ago, seemed to find merit in the fact that a certain locomotive which it illustrated was "the heaviest of its size in the country"! It was an engine of quite ordinary type—4–4–0—the design showing neither originality nor "art," though the details might, indeed, have been hewn out of stone like a recent memorial panel, about which we hear so much to-day.

Is it not time for the technical Press, at least, to welcome the fact that in the recent trials it is not the heaviest and longest, but the lightest and smallest locomotive which has done best? That surely is a scientific fact of great importance, for the causes of which we should all seek diligently.

June 15th. SPECTATOR.

SIR,—Interest having been shown in the recent exchange of locomotives, and the work between Westbury and Savernake, a summary is enclosed giving—in addition to the times taken on two runs in the trials week—another trip I had on the Up Limited, when an ordinary G.W.R. four-cylinder locomotive with a ten-coach train of 351 tons ran the 25¼ miles to Savernake in 25½ minutes.

The first 7 miles after Westbury are level, and afford opportunity of recovering speed after the curve slow to 30 miles an hour. The difficulty of the climb commences at post 88, after which 5¾ miles rise at 1 in 222. The remaining gradients are much broken ; in fact, 1½ miles after post 78 fall mostly at 1 in 315, and from post 75 follow 2 miles mainly level before engines face the last 3 miles rising slightly steeper than 1 in 200.

The runs were timed at every milepost in the section on the last two runs, and also in the first, except at three, where the slack was in operation.

On the rise at 1 in 222 after post 88, No. 4074 ran the first 4 miles in 3 min. 42 sec., and then suffered from the slack. No. 4060 required 5 min. 55 sec. for the 6 miles, and No. 4474 occupied 6 min. 22 sec.

The minimum speeds occur on the last mile to post 70, about 9 chains east of Savernake platform. The numbers of seconds per mile (taken from recorded passing times) on each of the final 5 miles are given below :—

No. 4074, 56, 55, 55, 56, 58 = 4 min. 40 sec.
No. 4060, 57¼, 56, 56½, 58, 60 = 4 min. 48 sec.
No. 4474, 50, 54½, 56½, 58, 59 = 4 min. 38 sec.

The respective minima were therefore 62.1, 60, and 61 miles per hour.

I travelled as an ordinary passenger in the train worked by No. 4474 and noted times with utmost care.

Westbury to Savernake, 25¼ Miles.

	G.W.R., 4074, 358¾ tons, 27.4.25.	G.W.R., 4060, 351 tons, 1.8.23.	L.N.E.R., 4474, 324½ tons, 2.5.25.
Westbury (30 m.p.h.)	m. s.	m. s.	m. s.
Milepost 95, pass ..	0 45 ..	0 53 ..	0 59
Milepost 90, pass ..	5 56 ..	6 9 ..	6 40
Milepost 88, pass ..	7 43 ..	7 57 ..	8 37
Milepost 86, pass ..	9 29 ..	9 46 ..	10 36
Milepost 84, pass ..	11 25 ..	11 45 ..	12 46
Milepost 82, pass ..	P.W.R. ..	13 52 ..	14 59
Milepost 80, pass ..	17 4 ..	15 54 ..	17 1
Milepost 75, pass ..	22 3 ..	20 37 ..	21 38
Savernake, pass ..	26 37 ..	25 18 ..	26 10
Milepost 70, pass ..	26 43 ..	25 25 ..	26 16

On the occasion when the Westbury-Savernake section was run in 25 min. 3 sec., referred to by your correspondent of last week, I travelled on the footplate, and no doubt the driver was anxious to do well ; but the driver of No. 4060 had no idea his running was being timed. ALBERT V. GOODYEAR.

Stourbridge, June 14th.

SIR,—Surely the significance of these trials is that they have promoted the old spirit of friendly rivalry so essential to this nation if it is not to be wiped out in the quite clearly coming troubles. Much is due to Sir Felix Pole, if report speaks truly, for arranging a test of the splendid productions of the Swindon and Doncaster shops, and the detail of the results is as nothing compared with the first action since the railways combined to remove that "sloppiness" that one began to think had bitten irrevocably into British business. RUGBY.

June 15th.

LECTURE COURSES AT GRENOBLE.

SIR,—In view of the existence of an exhibition dealing with hydraulic power at Grenoble in the French Alps, it has been proposed to revive the holiday course of lectures on water power and electrical power transmission at the University of that city. Provided a sufficient number of students come forward, the course would be from August 4th to 30th next.

The city itself is within easy reach of a number of interesting installations, and at the exhibition things are to be seen which would give practical illustration to many matters dealt with. The lectures, given by men of practical experience, will be in easy French, so that those who have learned French at school should have no difficulty in following them. The course is not intended solely for young students, but those who are under twenty-eight years of age can, by giving notice, obtain tickets at half fares from London to Grenoble.

The fees for the lecture course are low, and a local committee exists to assist students to find accommodation at very reasonable rates. The subjects of water power and transmission of power are of increasing importance in the United Kingdom and British Empire, and therefore a course of about thirty lectures on each subject, with conducted visits to some local stations, should appeal, not merely to many technical college students, but also to some people of more mature years who are not too grand to combine the acquisition of some useful knowledge with a holiday amid pleasant surroundings.

Shortly after the war, having learned of the long-standing success of the holiday courses in the French language at this same University, I proposed that a holiday course should be given on electrical transmission in what might almost be termed the cradle of French water power, and several courses were given. The secretary of the Office National des Universités Françaises, of 3, Cromwell-gardens, South Kensington, will give every assistance to intending students. THEODORE RICH.

Westminster, June 16th.

SIXTY YEARS AGO.

"SHALL we shock our readers," we wrote in our issue of June 16th, 1865, "by asserting that we find pleasure in the fact that two accidents of great magnitude have rendered a single week memorable in the annals of railway management?" The two accidents between them involved the loss of nearly two dozen lives. One occurred on the Great Western and the other on the South-Eastern. We found pleasure in them because we rejoiced in the fact that through them "a rod of iron has at last been laid on those who, knowing their duty, elude its discharge by every available means which parsimony can suggest or penury dictate." If lives were to be lost, we argued, it was better that the loss should be concentrated, for in such way only could the directors of our railways be made to realise the vast responsibilities they had accepted. Our argument was based on a belief, that we had long held, to the effect that the prevention of railway accidents was merely a question of money. In both the accidents, the true cause of disaster lay in the fact that the road was out of order, and we suggested that no security against a recurrence of similar accidents would be obtained until the railway directors retained the services of proper superintendents of permanent-way—men of a class who were not to be had for 35s. a week. The disasters, we held, were not accidents at all, but conjured up thoughts of manslaughter, and even the sixth commandment. Sydney Smith, we quoted, said that accidents would be things of the past when a bishop had been sacrificed. We wondered whether a score of ordinary mortals would be taken as ranking as the equivalent of a bishop. Although we did not record it at the time, there was one involved in the mishaps, who although not a bishop belonged to the "immortals." Charles Dickens was a passenger on the ill-fated South-Eastern train. From the shock of seeing the disaster he never recovered. He died exactly five years later to a day.

BOOKS RECEIVED.

L'Enseignement Technique—Bulletin Mensuel du Musée Professionnel de l'Etat à Morlanwelz-Mariemont. No. 4. Avril. 1925.

The Journal of the Royal Agricultural Society of England. Vol. 85. London : John Murray, 50A, Albemarle-street, W. 1. Price 15s. net.

The Strength of Materials. Second edition. By E. S. Andrews. London : Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 13s. 6d. net.

Theorie und Konstanten Bestimmung des Hydrometrischen Flügels. By Dr. Ing. L.A. Ott. Berlin : Julius Springer, Linkstrasse 23-24, W. 9. Price 4.50 gold marks.

Official Guide to the British Empire Exhibition, 1925. Edited by G. C. Lawrence. London : The Fleetway Press, Ltd., 3–9, Dane-street, W.C. 1. Price 1s. net.

Compressed Air and its Machinery. By T. H. Plummer. London : The Association of Engineering and Shipbuilding Draughtsmen, 96, St. George's-square, S.W. 1. Price 10s. net.

Mechanical Appliances, Mechanical Movements and Novelties of Construction. Fifth edition. By G. D. Hiscox. London : Constable and Co., Limited, 10, Orange-street, W.C. 2. Price 21s. net.

Quantities of Materials for Concrete. By Duff. A. Abrams and Stanton Walker. Second edition, being Bulletin No. 9 of the Structural Research Laboratory, Lewis Institute, Chicago. Published by the Laboratory. 1925.

Wellington (New Zealand) Harbour Board : Statement of Accounts with Annual Reports and other Statistics for the Period ended September 30th, 1924. Wellington : Printed by Warnes and Stephenson, Ltd., 127, Tory-street. 1925.

Der Rahmen ein Hilfsbuch zur Berechnung von Rahmen aus Eisen und Eisenbeton mit Ausgeführten Beispielen. By Dr. Ing. W. Gehler. Third enlarged edition. Berlin : Wilhelm Ernst and Sohn. Wilhelmstrasse 90, W. 66. Price 19.50 gold marks.

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* Inst. M.E., "Proceedings," April, 1904, page 406.
† Inst. C.E., "Proceedings," Session 1913–1914, page 33.

The Grenoble Exhibition.

THE exhibition which was opened recently at Grenoble, in the south-east of France, is concerned with water power development and world touring, Grenoble being an important centre for both forms of activity. It has been organised by the co-operation of the city of Grenoble, the local Chamber of Commerce, the Department of Isère, and the French Government, and will remain open until the end of October. Grenoble is one of the most important industrial centres in the French Alps. It is on a branch that leaves the P.L.M. main line at Lyons, and is served by through carriages from Paris. Though the interests served by the Exhibition are, on the surface, diverse, there is this connection between touring and engineering that in order to encourage tourists, heavy engineering works in the way of roads have been constructed in a number of countries. As an example of this, largely through the instrumentality of the P.L.M. Railway and the co-operation of the French Government, improvement in roads has been made from Alsace to Nice, through Aix-les-Bains and Grenoble to form the "Route-des-Alpes," some sections, for instance, that of the "Lautaret," involving long tunnelling work. It is desirable also that the touring public should realise that the construction of hydraulic works does not necessarily involve the spoiling of picturesque scenery, the construction of the Vyrnwy dam being an example of this.

Like so many exhibitions, it was very much behindhand at the time of opening, but it is expected that it will be completed in time for the World Water Power Congress, which takes place from July 4th to 11th. A Congress on Forestry is to be held from the 22nd to the 30th of the same month. This subject has a material bearing on rainfall, which latter is in itself all-important for those interested in water power. A Congress on Industrial Chemistry has been arranged for October next. Owing to the considerable activities in the way of electro-chemistry and electro-metallurgy which exist in the neighbourhood of Grenoble, thanks to the availability of so much water power, this Congress should give rise to discussions of materal interest.

It might be pointed out that, for the convenience of those who wish to take part in the congresses or visit the Exhibition, a bureau has been opened at the Grenoble railway station by the "Syndicat d'Initiative" to assist visitors to find accommodation either inside the city or in some of the watering-places in the hills nearby.

In the main water power building the leading French water power undertakings show a number of contour models, wall diagrams and photographs of dams, power stations and power lines. The policy of British politicians in arranging during the war for a higher price of coal for export than for home consumption, and the recommendations of the Sankey Coal Commission found their echo in the determination of many French people interested in industries and transport to be free from the "demands" of those interested in British coal, and that factor has had a great deal to do with the rapid development of water power in France; but, as a matter of fact, the movement towards the utilisation of water power in France started at the end of the last century in the basins of the Upper Rhone and the Isère, and has now spread across the south to the Pyrenees and the somewhat volcanic districts round Auvergne and the "Massif Centrale."

The successful electrical operation before the war of branches of the Midi Railway, notably one near Lourdes, encouraged the development of water power for railway purposes generally, and several installations of considerable interest are now complete or nearing completion. In the Pyrenees, as in some other districts in the south, the streams have in a number of places cut their ways into regular canyons in sound rock, and that feature has encouraged the use of the lateral rock tunnel, with its frequent points of access for construction, to take the head canal. In some places expansion chambers have been built in the rock.

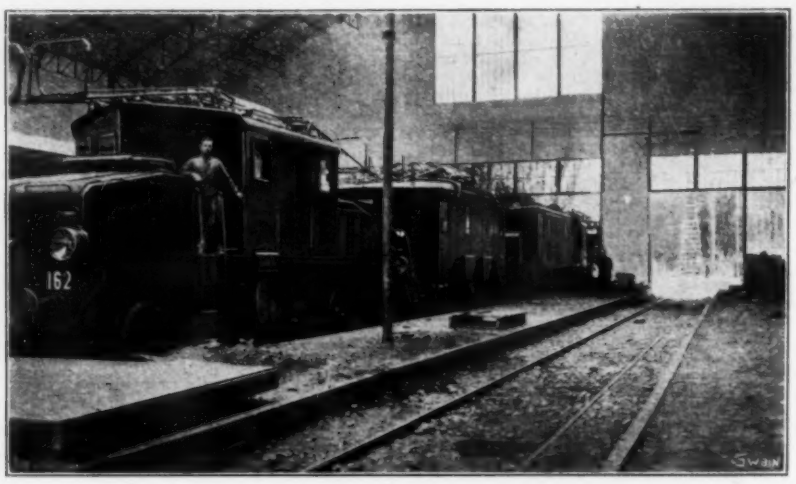
One installation is at present under construction with an underground power station deep in rock, of dimensions and output considerably greater than that of the well-known underground station at Porjus, in Sweden.

The firm of Bouchayet et Vaillet, of Grenoble, a firm that has specialised for a number of years in the supply and erection of pressure pipes and water fittings for hydro-electric stations, exhibits various fittings and some interesting photographs of work carried out, including a case in which a large diameter stiffened pressure pipe has been carried over a side gorge in the form of a bow, the end thrust being taken up at anchorages in rock at each side.

Up to 1914 there were practically no installations at very high pressures in France, but since the war developments in America, especially on the Pacific slope, have had their reflexes on the Continent, and a number of installations from about 100,000 volts and upwards are now at work or under construction. One installation comparatively recently set to work is that of the Lower Isère at the junction with the Rhone, near Valence, with transmission at 110,000 volts, and feeding a section of the Midi Railway at 160,000 volts.

Up to about 50,000 volts roadside transmission, for which French law gives special facilities, is very usual, armoured concrete posts being adopted in districts where road facilities diminish the inconvenience of transport.

Most of the long-span transmission towers for very high voltages, shown in photographs, are of pyramidical form, with hanging brackets, although there are some which



ITALIAN LOCOMOTIVES AT THE GRENOBLE EXHIBITION

are like a square-shaped tennis racquet with the conductors in triangle, one hung from each of the outer corners and one hung inside the frame from the top.

If one can judge by exhibits of chain insulators on view in the French or Italian sections, up to the first days in June, there do not seem to be any material alterations, either in the shape of the insulating parts or in the composition of the insulating materials, the principal improvements being mechanical, such as the fixing of the cap and suspender. Porcelain seems still to take the lead, although some French engineers say that for medium voltages near the sea glass has material advantages.

The firm of Crozet-Fourneyron et Cie., of Le Chambon-Loire, show, among some modern turbine apparatus, a turbine wheel of 1832, from the testing laboratory of Monsieur Fourneyron. The first Fourneyron turbine was put to work at a forge on the Laône in 1827. As a contrast to this small wheel, we noticed that Franco Tosi, of Legnano, in Italy, is exhibiting a Francis turbine of 35,000 horse-power. The Italian power companies make a very good show. Rapid development is taking place, not merely in the region of the Alps and Northern Apennines, but also in Southern Italy, Sicily and Sardinia. The climate and conditions resemble in some places those of parts of Southern India, that is to say, a heavy rainfall takes place for a short time, and then the country gets dried up. Dams are being built in a number of places to hold up the water and irrigation is being developed hand in hand with the water power. An installation, for example, is under construction in Calabria which will develop some 100,000 horse-power, arrangements being made to take the power across the Straits of Messina to Sicily, there being many small industries in the north-east of that island which will be greatly assisted by power supply at reasonable rates. Italian makers of cables, insulators and apparatus have a creditable show, for an exhibition outside their own land, and there is little doubt that for apparatus connected with engineering and industrial electricity supply, Italy is nearly self-supporting. The Italian is a good mechanic, and when left alone by the agitator is a hard worker; events since the general strike a year or so back, however unconstitutional they may have seemed to those who have not had equal dangers to face, have undoubtedly led to an industrial renaissance and a desire for Italy to become a first-class, materially self-supporting Power from the economic point of view. The rapid development of water power and the great expansion in artificial silk and other branches of the textile industry are in a way evidence of this. Nearly three million horse-power has been developed in Italy.

The Swedish Government has a building devoted to hydraulic power and touring. One of the features is a model of the Trollhättan power works, showing the enlarged Göta ship canal and locks, another is a panorama across the end of the building showing part of the Luleå-Gellivara-Narvik electrically operated railway, built primarily for the transport of iron ore to the Norwegian ice-free port at Narvik.

A large-scale model is shown of a 2-6+6-2 single-phase electric locomotive for the above-mentioned railway, 126 metric tons total weight, 16.7 metric tons per driving axle, capable of drawing 1400-ton ore trains.

A photograph and diagrams of several of the Swedish State water power systems are also exhibited. About 1½ million horse-power has been developed or is under construction in Sweden, out of an estimated available total of 6 million.

There are some items of interest in the railway building. In the first place, as a contrast to some of the modern electric locomotives, a 2-2-2 steam locomotive, Pierrot, built by Stephenson in 1846 for passenger traffic, is on view. It was used for some time to haul 150-ton passenger trains from Lyons to Avignon at about 28 miles an hour. The locomotive has been cleverly done up to look like new. Its grate area is .84 square metres, cylinders 13in. by 24in.

There are at present on view in the railway building five heavy electric locomotives, three belonging to the Italian State Railways and two French. It is understood that more will be installed very shortly.

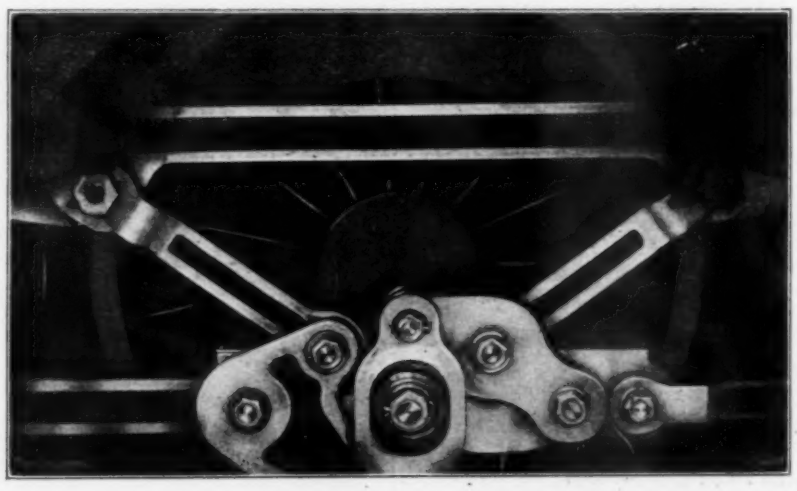
The three Italian locomotives are for use on three-phase railways; the accompanying engraving shows them. All three locomotives are driven by two motors through side rods and cranks. The first, by Messrs. Ansaldo, is of the 0-10-0 type. The motors, which are 1300 horse-power each, are wound for 3500 volts, 16⅔ periods, and can be put into parallel or into cascade. The locomotive weighs 75 metric tons, and will give a maximum draw-bar pull of 12 metric tons. A number of these engines are used on the Turin-Busolano line for goods and stopping passenger trains.

The second locomotive is of the 1914 type, built by the Italian Westinghouse Company. It is fitted with a new type of link work—see below—between motor cranks and drivers. It weighs 75 tons and has four speeds and a 2-6-2 wheel arrangement.

The third Italian locomotive is of a new type, made by Ernesto Breda, of Milan, 2-8-2, and has some distinctly novel features. It can be operated either on a 3500-volt, 16⅔ circuit, or on a 50-period, 10,000-volt circuit; in the latter case a transformer is placed between the line and the motors. It weighs 95 tons, and will be used on a section between Rome and Solmona, through part of the Southern Apennines. All three Italian locomotives are fitted with air displacement liquid resistances, a modification of a type originally developed for use on the Valtellina Railway. A new type of combined reverser and circuit breaker fitted with laminated contacts and immersed in oil is shown separately by the Italian Railways.

The two French engines are a 4-6-4 high-tension direct-current passenger locomotive, of the Midi Railway, made at Tarbes by the Constructions Electrique de France, and a 0-4-4-0, 750-1500-volt, direct-current locomotive, of the State Railways, which is one of a number designed to haul passenger trains from the Underground Invalides Station to the through station at Versailles-Chantiers. It is fitted with four geared motors, 275 horse-power each, on one-hour rating, and is intended for a maximum speed of 110 kilom. per hour. The equipment is of the electro-pneumatic multiple unit type. The engine weighs 62 metric tons, and will give 12 metric tons maximum tractive effort. It is fitted with speed indicators in each end cab, each driven off an extension of the outer axle connected through bevel gear and a telescopic revolving tube.

The Orleans Railway has on view several models of types of locomotives which it has under construction. The Northern Railway exhibits some motor-driven signal apparatus and an electrically operated fog signal. It is remarkable that in France the red and white square chess-board plate turned on a vertical pivot seems to be still preferred to a semaphore as a signal, despite the fact that



NEW TYPE OF LINK WORK ON ITALIAN WESTINGHOUSE CO'S ELECTRIC LOCOMOTIVE

in many situations the supporting structure has to be somewhat clumsy and expensive, as compared with the semaphore. The frequent use of a double red light changing to white, as compared with a red and green, or the latest red, orange and green, seems distinctly strange to English eyes. In France and on the Continent generally greater advances have been made with rolling stock than with the road bed or signalling, and it is not often that one sees a stretch of rails kept like a section of British main line. France, however, suffers from a material shortage of man power, thanks to the terrible war losses, and that may account for a good deal.

A somewhat novel travelling sub-station is also shown by the Italian State Railways Administration. It is arranged so that connection can be made to a three-phase line, 16⅔ periods at 102,600 volts in star or 59,300 in mesh with a low-tension voltage of 3700–4460, 2250 kilovolt-ampères normal output, with cos $\varphi = 8$. The plant is arranged with a high-tension circuit breaker, a transformer and an instrument and operating cab. It is placed on a long truck supported on two six-wheel bogies. The plant and truck complete has a tare weight of 90 metric tons. It was constructed by the Officine de Savigliano, of Turin.

Institution of Mechanical Engineers.

EXAMINATIONS, APRIL, 1925.

(*Note.—Success in these Examinations does not of itself constitute the Candidate a Student, a Graduate or an Associate Member.*)

STUDENTSHIP EXAMINATION: *Passed.*—E. Anderton, Hull; O. H. Arkell, Swindon; W. B. Atkinson, Hetton-le-Hole; J. Ball, Warrington; H. F. Barnes, London; W. Barrett, Keighley; W. R. Bedford, Keighley; R. R. Beesly, Derby; D. E. Brooks, Southampton; F. T. Brown, Ashford; E. C. Bryan, Dublin; A. L. Byrne, London; R. C. E. Cable, York; C. W. E. Chilton, Wolverhampton; S. Craggill, Darlington; J. Darlington, Wolverhampton; A. Day, Hull; A. de B. Edye, Basingstoke; T. J. Farbridge, Eastleigh; C. Faulkner, Hull; L. Finlayson, Southampton; R. B. Gillham, London; W. W. Greenfield, Hull; G. W. Hall, London; P. G. E. Hand, Hull; N. Hargreaves, Keighley; N. C. Hartmann, Sudbury; J. W. Harvey, Derby; F. G. Haslehurst, Birmingham; J. S. Haywood, Stourport; F. Heap, Accrington; D. L. Hesketh, Tadcaster; C. Higbet, Derby; H. J. W. Holding, Stafford; A. W. Honer, London; J. Hudson, Horwich; J. R. Hutchinson, Basingtoke; H. S. Jennins, Liverpool; J. A. R. King, Lincoln; A. H. Kirkby, London; E. Laister, Beverley; E. A. Laundy, London; F. W. Laycock, York; D. H. Marlow, London; W. O. Meek, W. Bridgford; J. A. Mitchell, London; T. W. Neal, Erith; D. A. Parker, Harrow; T. R. Platt, Hull; L. Y. Pringle, Erith; L. Rigg, Doncaster; T. R. A. Robson, Darlington; D. C. Ross, Lincoln; D. A. Russell, Bedford; H. G. Rust, London; W. Sadler, Hull; G. Saxton, Bedford; A. H. Scruton, York; D. H. Sharp, Rotherham; R. F. Smith, Darlington; W. Sowden, Bradford; F. W. Stone, Nottingham; J. W. Stubbs, London; J. H. Suthering, Darlington; H. O. Swannell, Colchester; H. W. R. Tame, Basingstoke; A. H. Tarrant, Leicester; R. H. Taylor, Lincoln; C. J. Templeman, London; E. C. W. Thompson, Birmingham; L. J. Thompson, Harrow; N. V. Tod, Erith; J. H. Tomlinson, Alfreton; W. Travis, Hull (received honourable mention); H. R. Tyrrell, London; G. H. Waite, London; J. E. Weller, London; H. N. E. Whiteside, Hull; G. S. Wood, Armley; F. Wright, Hull (awarded a prize to the value of £3); A. P. de W. de Wytt, London.

Passed Section A (a) [*Modern Language*] *of the Associate Membership Examination (Option permitted to Studentship Candidates).*—E. Anderton, Hull; H. F. Barnes, London; D. E. Brooks, Southampton; E. C. Bryan, Dublin; A. L. Byrne, London; T. J. Farbridge, Eastleigh; C. Faulkner, Hull; R. G. Fiegehen, Birmingham; W. S. Groom, Hull; P. G. E. Hand, Hull; A. W. Honer, London; J. Hudson, Horwich; J. R. Hutchinson, Basingstoke; H. E. Kemp, Southampton; J. A. R. King, Lincoln; E. Laister, Beverley; F. W. Laycock, York; D. H. Marlow, London; J. Mason, London; W. O. Meek, W. Bridgford; T. R. Platt, Hull; D. A. Russell, Bedford; E. A. Steel, Cheltenham; H. W. R. Tame, Basingstoke; A. H. Tarrant, Leicester; W. Travis, Hull; J. J. Walsh, Dublin; H. N. E. Whiteside, Hull.

ASSOCIATE MEMBERSHIP EXAMINATION [* *S.I. Mech. E.*: † *G.I. Mech. E.*] *: Passed.*—A. G. Abel,* Dundee; C. G. Bainbridge, Enfield; D. E. Burns,* Birmingham; D. M. Cannon,* Shoreham-by-Sea; J. S. Caswell, Swansea; J. M. Chrystal, Bradford-on-Avon; A. J. Crocker, London; W. H. Evans,* Wolverhampton; P. Franklin,† Brighton; F. Graham,* Bolton; E. E. Griffiths,* Blundellsands; G. A. Hankins, Teddington; E. J. Hogben, Oxford; E. J. Howlett, London; E. S. Hunter,* Erith; S. H. Makepeace, London; D. G. Mead,* Erith; J. Milton, Bristol; W. J. Morgan, London; J. E. Norris, London; F. M. Panzetta, Bradford-on-Avon; J. F. Petree, Kew; E. C. Phillips,* Leicester; H. Phillips,* Bedford; W. N. W. Piercy,* York; H. Rogers-Jenkins,* Rochdale; A. S. Rowley,† Manchester; R. C. Springthorpe,* Derby; E. S. Teesdale,* Nottingham; A. Walker, Worcester; C. F. Wells,* Lincoln; F. E. Whitehead,* Nottingham; D. Williams, Farnborough; W. Wilson,* Birmingham.

Passed Sections A and B Only.—H. McD. Alexander,* Dundee; A. R. Almond,* Nottingham; T. B. Battye,* Lincoln; A. E. H. S. Dowman,* Lincoln; W. Guthrie, Forfar; J. Lawrence, Dundee; M. H. Putman, London; J. Taylor, Aberdeen; E. S. Wilkinson, Wigan.

Passed Section B Only (Already Passed or Exempt from Section A).—H. Benson,* Lincoln; R. F. Bonallack,* London; E. G. Bradshaw, Birmingham; G. C. Jennings,* Redhill; R. J. Moffett,* Gillingham; M. R. Nicholson,* Fareham; C. W. Parris,* Wakefield; R. D. Petrie,* Hull; V. A. Prince,* Loughborough; C. H. Rowe,* Basingstoke; F. D. Sales,* Hull; G. E. Scholes,* Swindon; A. W. Simmons, London; F. C. Sleight,* Hull; C. J. F. Soper,* Bedford; B. Webber,* Lincoln; S. H. Whitaker,* Leeds; S. T. Willcox,* Wells; H. P. Yates, Sturry.

Passed Section A Only.—R. F. Alexander,* Dundee; G. Clark, Kirkcaldy; G. A. Evans,* Worcester; H. Finlayson,† London; O. E. Gosling,* Lincoln; W. G. Grossmith, M.C., Bristol; E. H. Hall,* Birmingham; R. Inglis,* Middlesbrough; S. Y. Jacobs, Loughborough; F. Jenkinson, Huddersfield; J. J. Johnston,* Dublin; F. G. Lambert, Leicester; W. P. McBride,* Dublin; W. J. McLeod, Aberdeen; R. McG. Malloch, Preston; S. T. L. Mansell, London; J. H. L. Maund,* Wolverhampton; J. F. Randall,* Southsea; S. M. Redford,* Eastleigh; A. Scrimshaw, Birmingham; P. Shearer, Edinburgh; A. Simpson, Lincoln; G. S. Stone,* Southampton; B. Woodhead,* Leeds.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(*From our own Correspondent.*)

Quiet Conditions.

QUIETUDE reigns in the Midland iron and steel market. Demand is small alike for iron and steel, and producers are adjusting output to the prevailing conditions. There is little of an encouraging nature, and the general market tone is deteriorating. Ironmasters are becoming pessimistic, and steelmasters complain that business at the cut figures they are compelled to accept to keep plants active do not leave a margin for profit. Tonnages are small all round, material being for immediate use. No big-scale contracts are reaching this district. Black Country forges are still very badly off for work. The market finds itself in a position in which price stability is impossible. Weakness characterises every department.

Effect of the Heat.

The workers in the furnaces of the steel and iron works of the Midlands and Staffordshire have been seriously inconvenienced by the hot weather, and in many of the heavy engineering establishments work has been commenced early morning and ceased at mid-day. In South Staffordshire the operatives engaged in the iron, chain, nut and bolt and other heavy trades, who have to face hot furnaces, have been compelled in some cases to cease their labour. The general acceptance of the eight-hour shift has relieved the strain formerly imposed by the long hours worked, and stoppages in hot weather are not now quite so frequent.

Pig Iron.

The pig iron situation is practically unchanged, demand being sluggish and values tending to weakness. Though quoted prices are easier in other districts, they are practically unchanged here. A usual condition of small purchases is quick delivery, indicating that very little pig iron is in the hands of users. The position is becoming very serious from the smelters' point of view, and output is again being reduced. Several Northamptonshire furnaces have been damped down or are understood to have reached a point at which there is no alternative to damping down. Derbyshire smelters are seriously considering the risks which they run in adding further to existing stocks. Scarcely any forge iron is being called for, and the orders coming on to the market for foundry grades are for small tonnages to meet immediate requirements. The recent giving way of prices has unsettled the market, and consumers of pig iron continue tp press for further concessions, holding that fuel values are lower. They do not doubt that if they tested the situation with a firm offer of bulk business at something appreciably less than the quoted price, it would be accepted. For the small tonnages required, however, Derbyshire smelters want £3 8s. upwards for forge quality, and £3 12s. 6d. for No. 3 foundry. Northamptonshire furnaces adhere to the £3 4s. figure for forge, and £3 7s. 6d. for foundry grade iron. British pig iron is not now competitive in foreign markets, and Belgium is offering material in this district. At present, the delivery figure is nearly 9s. over the local brands, but, in some cases, this iron can be bought favourably on the coast. Some attention has this week been paid to the recently established statistics of pig iron production for May. It amounted to 568,000 tons, compared with 569,800 tons in April, and 650,900 tons in May, 1924. The furnaces in blast at the end of the month numbered 15, a decrease of one since the beginning of the month, and a decrease of 34 compared with the number in blast at the end of May, 1924. The production included 170,200 tons of hematite, 200,300 tons of basic, 180,700 tons of foundry, and 26,500 tons of forge pig iron.

Steel.

Steel orders are practically all for constructional material, which is still called for in good quantities. Inquiries have increased a little lately, but competition, both internal and external, is keen, and prices have to be cut very fine to secure any share of the orders going. Quotations on 'Change in Birmingham to-day—Thursday—were the same as last week, but there is little hesitation about shading them when desirable specifications are in question. Angles and joists at £8 7s. 6d. are in fair demand, as are tees at £9 7s. 6d. A few steel works hold out for £8 10s., but they usually see the business go to competitors who are willing to accept the lower figure. Ship bridge and tank-plates command £9 to £9 5s., and boiler-plates £13. Staffordshire steel hoops sell fairly well, at £11 10s. at works. Steel strip has depreciated fully 5s. per ton, being obtainable at date at £8 15s. It is being extensively used now in the Midlands in place of wrought iron strip, which costs £4 per ton more. Steel scrap, which can be bought at bargain prices, continues a drug on the market, having scarcely any sale. Mild steel billet values are irregular. While some works demand £7 others are prepared to accept £6 17s. 6d. Welsh firms offer supplies at £6 15s. and even £6 10s. is talked of. Belgian billets continue weak, quotations being in this neighbourhood £6 2s. 6d. delivered in the Black Country. It is of interest to note that last month the production of steel ingots and castings amounted to 651,600 tons, compared with 597,600 tons in April, and 809,700 tons in May, 1924.

Continental Competition.

Continental competition is very keen in the steel department. Belgium is not certainly seeking much business in semi-finished material, many firms declining to quote for billets, which have been the main item of export to this country in the past, but greater zeal is being shown by Belgium in the search for finished steel business, and very low prices are quoted. Germany is once more taking a hand in this department, sending over this week a long list of steel products including joists, bars, plates, &c., underselling even those of Belgium. British makers consider it hopeless to attempt to meet these prices, and are letting the business pass.

Finished Iron.

No visible effect has been made by the recent revision of bar iron prices. There is a relatively good demand for special grades for engineering bars, but standard lines are inactive. Quick delivery is a condition of most of the orders. Mills have so little business in hand, however, that they have only mechanical exigencies to consider. Makers have obtained a little relief in fuel costs, and in somewhat cheaper pig iron. Orders, however, are scarce, and far behind the tonnages necessary to give full employment. The arrival of summer weather will cut down production, and help in the maintenance of prices. The reduction in common iron steel leaves this class of material subject to destructive competition from Belgium, which is quoting No. 3 iron at £7 delivered. While that material is steely and unreliable for some purposes, it is still largely used for nut and bolt and chain making. For the latter purpose it is considered strange that where stresses are involved users do not more frequently specify for Staffordshire iron, which can be depended upon to give a safe chain. Wrought iron gas tube strip prices have eased somewhat, many makers having reduced their quotations 5s. per ton. This material is now obtainable at £12 15s., but has to compete with steel strip at £8 15s., consequently it is little called for.

Galvanised Sheets.

Business in the galvanised sheet department continues active, though new business is not forthcoming as freely as could be wished. Sheet manufacturers have still a considerable weight of orders to get through, in some cases insuring work for three months ahead. Buyers are endeavouring to get some concession off the £16 10s. quotation for galvanised corrugated sheets of 24-gauge, but that figure is, under the circumstances, easily maintained. Black sheets are selling more freely for motor building and other purposes. The tin-plate trade continues to show a decided improvement, orders coming in from all canning markets, with good lines for material for oil containers.

New Industries.

Last month I pointed out that new industries were being diligently sought throughout this district for the fuller employment of resources in *personnel* and plant, and referred to developments in progress in the Black Country in stainless iron and a new metal for deep sea cables. The prospects of the heavy trades in the immediate district are so dark that it behoves all concerned to be on the alert for substitutes which will fit the changed conditions. It is interesting to note that stainless steel is receiving new applications in Birmingham. Polished, it has wide decorative possibilities in combination with enamel. Heraldic and other designs can be etched on the shining surface and thrown into sharp relief by a coloured ground. There are many ways in which the ideas can be adapted, and some of them are already being put into execution in various directions. Buckles and other ornaments of feminine dress, as well as house fittings are being produced. The process is not costly, only simple machinery for pressing and piercing being required. The establishment of workshops in suitable centres is, I understand, contemplated.

Oil from Coal.

The coal industry is in such a distressed condition at the present time that it would perhaps not be out of the way to mention that other outlets besides those now in vogue for coal are being diligently sought. Research work is being carried out in the production of oil from coal by the Department of Oil Engineering and Refining at the University of Birmingham. Until operations were commenced at the Birmingham University only foreign coals had been experimented with, but the researches since carried out have shown that English coals can quite readily be converted substantially into liquid. The latter, however, differs from ordinary crude petroleum in that it contains relatively small proportions of substances not occurring in crude oil, but when they are removed the residual liquid consists entirely of hydrocarbons. Up to the present, several different types of English coals have been investigated, and Professor A. W. Nash states the results are encouraging. A South Staffordshire coal, on hydrogenation, gave 37 per cent. of liquid, a South Wales coal 26 per cent., and a Lancashire coal 61 per cent. These figures give respectively 80, 56 and 130 gallons of liquid per ton of dry ash-less coal. The researches so far carried out at Birmingham University have not been concerned with the commercial aspect of hydrogenation. The expense of such an investigation would be prohibitive and would be outside the scope of a University department. It is the opinion of many Midland engineers, however, that the problems should now be tackled in this country, though it is admitted there are many serious technical and mechanical difficulties which must not be overlooked before any considerable sums of money are spent in inaugurating a new industry.

Unemployment.

There is a further increase of 1331 in the numbers unemployed in the Midlands, the current total of 168,443 being greater by 10,952 than it was in the return issued a fortnight ago. The figure for the Stoke-on-Trent area has increased again from 16,728—last week—to 19,093. The general total for the area is made up as follows:—Men, 129,326; boys, 3178; women, 33,201; girls, 2738. To the total the Birmingham area contributes 24,892; Bilston, 3747; Coventry, 1124; Cradley Heath, 5310; Derby, 1236; Dudley, 3686; Leamington and Warwick, 314; Leicester, 4115; Northampton, 1726; Nottingham, 9757; Oldbury, 1518; Peterborough, 350; Redditch, 1009; Smethwick, 4204; Stoke-on-Trent area, 19,093; Stourbridge and Brierley Hill, 3934; Tipton, 2223; Walsall, 5787; Wednesbury, 3307; West Bromwich, 3369; Wolverhampton, 4949, and Worcester, 1406.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

General Conditions.

THE general condition of the markets here shows no sign of improvement yet, and people are in rather a doleful mood. It is felt that if the state of trade is to remain in this semi-comatose condition all through the summer, it will be impossible to keep prices even at their present low level. Without better business to sustain them, it is almost impracticable to avoid a slow sagging of values, and this tendency continued for three months is bound to make a serious difference. It is true that most prices now are on the level of costs of production, where they are not below it, as in the case of steel sections, but unfortunately this fact alone will not prevent a further fall unless there is a better demand than exists at present. Buyers here take a very pessimistic view of the future, although sellers for the most part maintain that the market is at the bottom.

Metals.

The copper market has been weak and depressed here for some time, and in the opinion of a good many people there should shortly be a rally again. The consumption of copper, both in Germany and in England, is far from bad, and so far as these two countries are concerned, the outlook is fairly good; but apparently the weakness is in America, and it is more difficult to ascertain the exact situation there. A larger demand for copper from Austria may be expected in consequence of the schemes for the electrification of the railways, for which the money is already provided. On the whole, it is very difficult to see why the price of copper should be much lower than it is now, although there are people who predict that refined ingot copper will yet touch £60 per ton in this country. Experts in the trade point out that part of the fall in copper has been caused by the appreciation of British currency; and no doubt there is some reason in this view, for the price in cents, as quoted from America, is not so low as it has been on former occasions. Tin is strong, and although there are fluctuations, the average for the week does not go down to any extent. America has kept up the market to some extent lately, and it is probable from the statistics that she still has a supply in hand; but it is thought that she must come in shortly. Lead and spelter have both been fairly steady markets here for some time. Lead is certainly at a fairly high figure, but people have been saying this for a long time, and yet there is no immediate sign of any coming slump. There is, however, some ease reported in the American market. The question whether lead is near the time when a considerable fall in values will occur is one of some interest. The output of metal has increased very considerably, and is now probably keeping pace with the consumption, and no doubt the high prices charged for lead sheets and pipes in this country tend to economy in their use. Spelter keeps rather a quiet market, with only a moderate demand in this country. German consumption is also said to be less than it was. Spelter is, however, at a moderate price compared with lead, and is therefore in a safer condition generally.

Pig Iron.

The demand for foundry iron in the Manchester district shows no sign of expansion yet. A moderate business is being done, but always at low prices. Consumers seem to be buying Derbyshire No. 3 usually, although there is a little business reported in Lincolnshire, and it is believed also that sellers of Northamptonshire will occasionally accept a price low enough to enable them to compete. It is fairly clear that this must be something considerably under 67s. 6d. on trucks at the furnaces, for that would mean 80s. 2d. here, and there is plenty of Derbyshire No. 3 to be had at 80s. One would say that at least 1s. per ton concession under the Derbyshire price would be needed to induce a Lancashire foundryman to consider Northamptonshire iron. Lincolnshire remains rather scarce, and commands a small premium, but so soon as there is more of it, the price will have to come down to 80s. here. There seems to be a general feeling of weakness all round, and this leads to the belief that we are not near the time when any advance in pig iron prices can be expected. Hence there is no disposition to buy forward. The Cleveland market is quiet and rather feeble, but it moves down only very slowly. It is said that Cleveland hematite is accumulating again, although the total make is comparatively small.

Finished Material.

The extreme dullness of the market for manufactured iron and steel continues, and there seems to be no expectation here of any change for the better. Steel makers are very sure that any further reduction of the prices is impossible in this country, but consumers do not seem nearly so convinced on this point; but, at any rate, it is clear that there are several eager sellers for every buyer that comes into the market, and in such circumstances it is obvious that cutting of prices must occur. The question is whether more works will be closed down under pressure of loss, so as to bring the production into better relation with the present demand. This is, of course, a drastic remedy, but it may have to be adopted unless it be possible for Great Britain to recover more of her export trade.

Scrap.

Dealers here seem to be very depressed about the prospects of the scrap trade. The difficulties of those who collect and prepare scrap for the market are considerably increased. Of course, where there is a substantial lot, all of one kind, it is possible to deal with it at little expense; but where there is sorting to be done, the labour charges are excessive as compared with the prices that can be obtained for the prepared material. For steel scrap the value here is about 50s. per ton; but for heavy wrought scrap from 72s. 6d. to 75s. per ton is paid by the ironworks. One can quite understand that a dealer is not too anxious now to see that every particle of steel scrap is sorted out of his wrought iron scrap. For cast scrap there is a moderate demand at 72s. 6d. to 75s. delivered for ordinary broken castings; but for "textile" machinery castings dealers ask 80s. to 82s. 6d. per ton.

BARROW-IN-FURNESS.

Hematite.

There is very little change to note in the hematite pig iron trade. There has been no further curtailment of output, but the Carnforth works are practically working only from day to day. Big stocks exist at other works, and are not being reduced at all rapidly. The Midlands are taking a moderate amount of iron and more pig iron will be shipped from Barrow to America in due course. The state of the market is still, however, decidedly dull, and there are no signs of an improvement at present. As far as Cumberland is concerned, the position is better than it is in the Furness district. The order for rails for the London, Midland and Scottish Railway will help the works out. Most of the iron produced is going at present into the steel departments. There has been no damping down at any of the Cumberland works, although stocks exist there as well, and are not being cleared with any speed. Foreign competition is interfering with trade in many respects. Foreign scrap is being dumped into the district at a price which cuts out local sellers. There is practically no trade with the Continent in pig iron at present.

Iron Ore.

The iron ore trade is feeling the pinch as far as Furness is concerned, but Cumberland is in a better position in view of there having been no damping down recently. On the other hand, such important mines as Hodbarrow are not experiencing much business, and the men engaged are working from day to day. There is not much life in the importation of foreign ores.

Steel.

The steel trade is in a very moderate way. The order for Cumberland from the London, Midland and Scottish Railway will keep the steel works employed for a period, but fresh orders will soon be required. Barrow, as far as the rolling of rails is concerned, is idle, the works being closed. Only the hoop and small section mills are working at Barrow. The steel works will remain closed as long as the ironworks are idle, and that may be for some time.

SHEFFIELD.

(From our own Correspondent.)

The Heavy Steel Trade.

So far as there is any change to report in the condition of the heavy trades of Sheffield and district, it is a change for the worse. This remark applies particularly to the semi-manufactured side, and is also true of raw materials. In pig iron and basic steel, there has been a further reduction of output since Whitsuntide. Probably not more than a fourth of the basic steel furnaces are in operation. A good many of the acid furnaces are also in want of work. Notwithstanding the low level of prices, there are few inquiries or orders for substantial quantities of pig iron or crude steel. At the Templeborough, Ickles and Stocksbridge works much plant is idle, while in the finishing departments short time is being worked. The railway departments continue to receive orders, but are not fully employed. Most of the work continues to come from the home companies, a large share of the oversea contracts for axles and tires being placed on the Continent. The orders for rails, reported last week, will not make much immediate difference to the state of trade, as deliveries will probably be spread over a considerable period, and will be called for as required. It is understood that the contract prices were lower than last year's. There is a fair demand for steel castings and forgings, but the position of these departments is not satisfactory.

The Lighter Side.

As has been the case for some time, the manufactured branches of the steel trade continue to enjoy a much better position than the semi-manufact red. The file and tool trades show a considerable revival of activity. Several of the large file works are fully occupied, and the trade as a whole is producing up to about 80 per cent. of its capacity. This is taken as a promising indication of improvement in the engineering trades of the country. In saws, scythes, shovels, spades and edge tools, there is more activity than has been the case for several years Certain of the tool branches are finding themselves unable to obtain sufficient labour to deal with the flow of orders, many of which are the result of an increased export demand. The call for engineers' small tools is on the quiet side. The trade in crucible steel is not by any means satisfactory. A further decline in orders is reported, and only a small proportion of the furnaces are at work. While the home consumption of tool steel remains at a fairly considerable level, there is a great lack of foreign business, owing to the depreciation in currencies.

Cutlery Slump Extending.

There is a further decline in the cutlery trade, the reports on which grow worse and worse. The amount of business done with Australia, which has long been the best overseas market, has lately shown a sharp falling off, while trade with Canada and other parts of the Empire is also much quieter than it has been. The present depression affects nearly every branch of electro-plate as well as cutlery, and large and small firms are suffering alike. Some of the small makers, who have hitherto done a large trade in cheap stainless knives, tea knives, spoons and forks in the home market, report a serious decline in demand. Good orders for cutlery and plate have recently been given out by some of the great steamship companies. In these contracts, knives of the old, non-stainless material are specified, and this has given rise to an idea that these large users have given up stainless and gone back to the older material. This impression is not correct, however. The adoption of non-stainless is not a reversion, but a continuance of the policy from which these particular buyers have never departed.

Sheffield's Abattoir.

There is a probability of progress being made at an early date with the erection of an up-to-date abattoir and wholesale meat market for Sheffield. The scheme has been under consideration for some time, and I have already reported the preparation of plans by Mr. Hal Williams, of London, the engineer who was called in by the Corporation. Delay has taken place owing to difficulty in agreeing with the butchers on the subject of charges, and those difficulties are not removed even yet; but the Corporation has decided to proceed with the scheme in a modified form. The original estimate for the abattoir has been reduced by £46,000, of which £20,000 is due to a reduction of the lairage accommodation by one-half, and the proposed expenditure on the meat market has been brought down by £16,600. The amount already expended on the scheme is £52,000, and the revised figures provide for a further expenditure of £320,000, made up of £214,000 on the abattoir and £106,000 on the meat market. The engineer has now been instructed to prepare detailed drawings and specifications, and the Town Clerk to advertise for tenders.

Cast Iron Houses.

Mortomley, near Sheffield, now possesses two very neat and pleasing demonstration houses of cast iron, faced with concrete, which have been erected by Newton, Chambers and Co., Ltd., of the Thorncliffe Ironworks. The houses were built with great rapidity, as I have previously reported, the actual time engaged in fitting the shells together being only about three and a-half days. Another claim made in their favour is that they require neither external painting nor pointing. They have been visited and inspected by large numbers of people, including housing authorities, from whom the builders have had inquiries for prices. Newton, Chambers and Co. have submitted a tender to the Wortley Rural District Council which wishes to build ten houses at Grenoside. The tender for the ten cast iron houses was £4570, while the lowest tender for houses of bricks and mortar was £20 less, a difference of only £2 per house. The Council has not yet decided as to the allocation of the contract. Messrs. Newton, Chambers erect the houses of plates of standard size, which are cast in their foundry at Thorncliffe, and they are now completing preparations for the production of the materials in large quantities.

Some Company Reports.

A satisfactory report on the past year's working has been issued by the Stanton Ironworks Company, showing an increased profit. The company states that the demand for spun iron pipes manufactured under the de Lavand patents still continues to increase, and the concrete pipes manufactured under the Hume patents also meet with growing demands. The development of the colliery in the Bilsthorpe area has been begun, and is being carried on as rapidly as possible. At the annual meeting of the Chesterfield Tube Company, the chairman stated that the order book was quite satisfactory, and was, in fact, considerably better than was the case at this time last year. The company, he said, had had very considerable orders given to it in connection with the new warships for the British Government. Its steel bottle trade was also very satisfactory. Another important feature was that it was busy developing the processes of manufacture of engineering requirements in connection with the latest up-to-date special alloy steels, and the progress made so far was so satisfactory that he felt justified in stating that the company might hope shortly to claim both successful and remunerative results.

NORTH OF ENGLAND.

(From our own Correspondent.)

Cleveland Iron Trade.

THERE are no signs of any improvement in the Cleveland pig iron trade, and unless there is a revival in business in the very near future, ironmasters will be confronted with a very serious situation. Even the present limited output is more than the market can absorb, and whilst ironmasters' stocks tend to increase the foreign producer is cutting the English makers out of the markets at home and abroad. Since the recent decline of the franc it has been almost impossible to sell Cleveland iron on the Continent, and French and Belgian makers are now invading the British market with success. Many of the Scottish foundries—usually good customers to this district—are buying foreign iron at shillings per ton below Cleveland's price, and there has been a corresponding curtailment of the demand for local iron. Even those consumers who still buy British pig iron defer their purchases to the last possible moment owing to the steady decline in prices, and this serves to accentuate the slump and render still more difficult the lot of the ironmasters, who must, of necessity, ensure continuity of operations. It is difficult to see how prices can fall much lower, as makers are already selling at a loss, yet at the same time it is by no means certain that the fall in prices has reached its limit; indeed, there are merchants still prepared to discount the market, and makers, too, are willing to bargain at lower rates if they are offered substantial business. Even for small lots No. 3 G.M.B. Cleveland pig iron is now quoted 73s. 6d., which

represents a fall of 7s. 6d. per ton since the beginning of the year, and is the lowest quoted figure since the year 1915. No. 1 foundry iron can be bought at 78s. per ton, No. 4 foundry at 73s., and No. 4 forge at 72s.

Hematite Pig Iron.

The hematite pig iron trade is without any feature of note. The demand is very quiet, and whilst some makers hold out for 79s. per ton for mixed numbers, there are sellers at 78s. 6d. per ton, and of No. 1 at 79s.

Ironmaking Materials.

The foreign ore trade is lifeless, and little interest is taken in the market position. It is reported that best Rubio ore has been offered at as low as 21s.6d. per ton c.i.f. Tees without attracting a buyer. The coke market has developed further weakness, and good Durham furnace coke is now on offer at 21s. per ton delivered at the works.

Manufactured Iron and Steel.

The manufactured iron and steel trade is still languid. Orders can only be secured by severely cutting prices. The galvanised sheet trade is still busy, but this can be said of no other branch of the industry.

The Coal Trade.

There is no improvement in the Northern coal trade. The situation generally continues unsatisfactory and disappointing, as buyers still hold off, and little progress is made regarding forward business. There are inquiries on the market, but they are distributed over a large number of merchants, and though giving the impression that there is a considerable volume of trade, they really amount to very little. The coal that is being shipped is under contract, except an occasional cargo of gas coal which speculators take up in the hope of making a little profit. Reports from the continental centres do not give much encouragement as to a revival of interest, at any rate for some time to come. Merchants who have returned this week from business journeys in France, Belgium, Holland, Germany, Sweden and Norway, state that they did not find any improvement in the demand for coal. Germany has very large stocks of fuel to dispose of at low prices, but the travellers do not despair of trade for British coal if the price is at the right level. Other business men take the view that the depression will last a while yet —perhaps other two or three years—but that it will be followed by a great boom in trade. The general trend of the Northern coal market remains easy and unchanged. The near approach of the annual holidays in the Northumberland coalfield has, however, tended to give a steadier tone to best steam coals, which are fairly well booked to the end of the month, and for the surplus holders are asking recent prices and declining to consider any concessions. There is very little movement for other steam qualities, and holders have difficulty in preventing prices still further receding. Best steams hold to 16s. 9d. to 17s. per ton. Gas coals are not in demand from any quarter, and home port demands are very slow. The bunker coal trade is quiet, but the demand is more active than recently, though not of sufficient volume to steady prices. The coke market remains quiet and stocks of gas coal are ample to meet all requirements and weak in tone at 16s. 6d. to 17s. Patent oven cokes are not very plentiful, but are in slow demand and weak at 19s. to 21s. 6d.

Cleveland Miners' Wages.

Notwithstanding the depression in the ironstone industry, the Cleveland miners have instructed the Executive Committee to prepare a revision of all miners' base rates with a view to establishing a substantial increase in the present rates. The Committee was also instructed to convene a meeting with the mine owners to discuss the matter. The mine owners are also to be asked to concede a week's holiday to all men and youths with pay, and to reduce the price charged for explosives.

SCOTLAND.

(From our own Correspondent.)

Meagre Demands.

THE general position in the steel, iron and coal trades does not show any change for the better, and markets on the whole are lifeless. In many instances, the normal sources of demand are almost non-existent meantime, and no fresh avenues of disposal have opened up. Weakening prices help to maintain the cautious policy which consumers have displayed for some time back, even the possibility of current quotations being shaded somewhat evidently being no inducement to anticipate requirements even to a limited degree.

Keen Competition.

Continental offerings of competitive material are fairly numerous, and somewhat easier in price than recently. Not only have local makers to face this, but they are also up against stiff home competition for any small orders passing. It is questionable, however, if the amount of business being offered justifies breaking prices to any extent, as even with quotations at the lowest possible minimum the turnover is far below the average.

Steel.

The position in the steel trade is much the same as for some time past. The drop in demand from shipbuilding yards and other sources has largely affected plates and sectional materials, and these are poorly bought, mills being kept running only with great difficulty. Black steel sheets have some good lines in the lighter gauges for export, but the heavy descriptions are slow. The strong point is galvanised sheets, which maintain a firm attitude, the price varying little from £17 10s. per ton for 24 b.g., f.o.b. Glasgow. Supplies of scrap materials are plentiful, and the demand slow.

Iron.

The iron market does not vary much, and prospects of an improvement are as vague as ever. Demands for bar iron are few for either home or export delivery, and employment remains somewhat problematical. The re-rolled steel department is perhaps a shade busier, but in order to obtain any business, exceptionally keen prices have to be conceded. Pig iron continues to weaken, although nominal prices show no change. The stocks on hand are still considerable, despite a minimum output, and prices can be arranged. Local orders are sparse and export is not much busier.

Coal.

So far as actual turnover is concerned, no change for the better is noticeable in the coal trade. Owing, however, to a curtailment of output and the arrival at certain ports of a few steamers, some qualities of fuel are steadier, if not actually firmer. Lanarkshire splints and first-class Fifeshire steams, and in a less degree double and single nuts and pearls, are affected. Ells are considerably affected by the lack of household business, and along with other fuels, apart from those previously mentioned, are weakening in price. New business with foreign countries remains meagre. Few cargoes are going to Denmark, although the strike there is at an end, and shipments to other destinations are curtailed. Aggregate clearances from Scottish ports, amounting to 203,295 tons, were better than the preceding week's total of 192,730 tons, but considerably below the returns for the same week last year, which amounted to 242,411 tons. The decrease in shipments to date, compared with a similar period last year, amounts to 713,572 tons, and compared with a similar period in the year 1913, to 2,281,273 tons.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Position.

THE general situation in the steam coal trade leaves a great deal to be desired, while even the anthracite trade is not as brisk as it was a few weeks ago, the result being that prices are weaker. The existing depression, however, affects the steam side of the industry most, as there is absolutely no life in the market, for the reason that the foreign demand is so meagre, owing partly to the keen competition from other coalfields, and partly to the fact that the foreign exchanges are so adverse to business. Since I wrote a week ago, scarcely any fresh inquiry has come on the market, and the conditions are all round quiet in the extreme. The possibility of untoward developments arising from the labour situation in little more than a month's time, fails to stimulate requirements from abroad. In the circumstances, it is not surprising that there is a lack of loading pressure at most of the South Wales docks, and that many collieries are experiencing some difficulty in finding an immediate outlet for their outputs, notwithstanding the numerous pits which are idle, and consequently curtailing the production of the coalfield as a whole.

Coalfield Items.

The Windsor Colliery, Abertridwr, which has just been purchased by the Powell Duffryn Steam Coal Company for £150,000, was taken over at the end of last week. All contracts between the workmen and the old company terminated and work has been suspended. According to a statement made by the men's agent, the new owners contemplate big alterations in the method of working the colliery, and the chief method of working the seams will be by means of conveyors. It is also the intention of the Powell Duffryn Company to introduce more up-to-date machinery, which will take some time to install, but the workmen will not be kept idle longer than is possible. About 100 men, including repairers and officials, were to start work on Tuesday morning last. Although about three weeks have elapsed, no steps have been taken by the miners' leaders at Blaenavon to re-open negotiations with the management, although on Whit Monday a mass meeting decided in favour of this action. The general manager of the collieries has stated that he is convinced that the sole and simple reason is that the men are receiving unemployment pay. The men employed at the Hafod collieries have been informed that unless they raise cleaner coal and less slack the company will be compelled to serve notices to terminate contracts. Trouble has also arisen at the Llanbradach Colliery concerning the alleged refusal to pay overtime to hauliers. About 2000 men are employed, and the pits were idle on Tuesday as a consequence of the dispute. It is understood that the company has declined to negotiate with the representatives of the workmen until the workmen decide to return to work.

The Ship-repairing Industry.

The conditions in the ship-repairing industry of this district have been very unsatisfactory for some time past, and on frequent occasions it has been attributed to the high costs of operating which has allowed other repairing centres in this country and abroad to capture orders. Compelled by the depression prevailing and the necessity for introducing more favourable conditions, the Bristol Channel Ship-repairing Employers' Federation has given formal notice to the trade unions concerned to terminate the existing working conditions and wages agreements at the yards at Cardiff, Barry, Swansea and Newport. Among the proposals of the employers is one of time and a-half, which is the national rate, in substitution of double time for all overtime work, while in the case of "dirty" work it is suggested that an increase of 10 per cent. upon base rates should take the place of the present time and a-quarter rate. It is also put forward that the allowance of 50 per cent. paid to men working more than 15ft. above the deck shall be abolished and substituted by an allowance of 10 per cent. A move is also made to do away with the "lieu" rates, upon which the boilermakers work, and a more comprehensive piecework list is to replace them. In the case of work upon oil-carrying vessels, the local employers have joined with the National Employers' Federation in negotiating a new national agreement. Provision is also made that in the event of disputes arising and a deadlock resulting, the questions at issue shall be submitted to arbitration by an independent person mutually agreed upon. No proposal is made for interfering with the existing working week of forty-seven hours.

Current Business.

The general inquiry on the steam coal market has been negligible during the past week, and prices have weakened in almost all classes of both large and small coals. The tone is depressed, as is natural when standing stocks of coal are in excess of requirements, and colliery salesmen are compelled to make concessions for prompt orders in order to enable them to find empty wagons with which to keep their pits working. The demand is not only slack for early shipment, but also for forward delivery, which gives rise to the belief that no immediate change for the better is likely, though it is difficult to say what may develop in view of the uncertainty prevailing as the result of the future negotiations on the wages question. At the present time there are more idle loading appliances at the various docks than tonnage waiting to berth, which shows the absence of loading pressure.

Catalogues.

JOSEPH ASH AND SON, Ltd., Rea-street South, Birmingham.—Booklet entitled "Galvanising."

HERBERT MORRIS, Ltd., Loughborough.—Book 81, dealing with Morris electric hoist blocks.

THE STEAM FITTINGS COMPANY, Ltd., West Drayton, Middlesex.—Leaflet on gas and air meters.

MARSHALL, SONS AND CO., Ltd., Gainsborough.—Publication 1514 on "Marshall" steam traction engines.

CROMPTON AND CO., Ltd., Chelmsford.—Leaflet entitled "Alternating-current Motors of Distinction."

ARCHIBALD D. DOWNAY AND SONS, Ltd., Steelworks-road, Battersea, S.W. 11.—Illustrated calendar card.

O. N. BECK, 11, Queen Victoria-street, E.C. 4.—Leaflet illustrating and describing the Kort forging hammer.

F. AND R. H. KIRKUP AND CO., 153, Pilgrim-street, Newcastle-upon-Tyne.—Brochure R.S. 2, dealing with rotary screens.

GOODBRAND AND CO., Ltd., Britannia Foundry, Stalybridge.—Catalogue concerned with the Goodbrand fuel economiser.

THE SHEFFIELD STEEL PRODUCTS COMPANY, Ltd., Templeborough Works, Sheffield.—Price list of "Produx" files and rasps.

DOWDING'S MACHINE TOOL COMPANY, Bush House, W.C. 2.—C. 876, a leaflet describing the Schuchardt and Schütte hardness tester.

KORTING BROTHERS (1917), Ltd., 64, Victoria-street, S.W. 1.—Catalogue, entitled "Appliances for Steam Users and Manufacturers."

THE MIRRLEES WATSON COMPANY, Ltd., Scotland-street, Glasgow.—Pamphlet No. 8610, entitled "Mirrlees Oil Mill Machinery."

THE STALKER DRILL WORKS, Ltd., Derby.—Price lists of the patented four-fluted taper pin drill and patented parallel drill and reamer.

JOHN DICKINSON AND CO. (BOLTON), Ltd., Fairclough-street, Bolton.—Descriptive booklet of rock asphalt for building and industrial purposes.

EVERSHED AND VIGNOLES, Ltd., Acton-lane Works, Chiswick, W. 4.—List No. 116 F. Illustrated description of recording Dionic water tester.

THE ANGLO GALVANISING COMPANY, Limited, Abbey House, Victoria-street, S.W. 1.—Booklet giving details of the cold process of galvanising.

D. G. SOMERVILLE AND CO., Ltd., 35, Grosvenor-place, S.W. 1.—A retrospect of the work carried out by the company during the last twenty years.

THE NATIONAL GAS ENGINE COMPANY, Ltd., Ashton-under-Lyne.—Folder No. 63, illustrating and describing the petrol-paraffin engine and its running.

THE ZENITH CARBURETTER COMPANY, Ltd., 40, Newman-street, W. 1.—Price list and catalogue which illustrates and describes the Zenith carburetter.

THE VACUUM OIL COMPANY, Ltd., Caxton House, S.W. 1.—No. 2 third edition of the Gargoyle Technical Series, entitled "Lubricating Oil Specifications."

THE CONSTRUCTIONAL ENGINEERING COMPANY, Ltd., Titan Works, Charles Henry-street, Birmingham.—Brochure No. 133, illustrating and describing the "Titan Cupolette."

ADAM HILGER, Ltd., 75a, Camden-road, London.—Pamphlet entitled "Applications of X-ray Spectrography and Crystallography to Metallurgy and to Chemical Problems."

CROFTS (ENGINEERS), Ltd., Thornbury, Bradford.—Sectionalised catalogue describing the various power transmission appliances manufactured and kept in stock by the company.

THE ENGLISH ELECTRIC COMPANY, Ltd., Queen's House, Kingsway, W.C. 2.—Publication No. 585, entitled "Reversing Mill Drive at the Penistone Works of Messrs. Cammell Laird and Co."

THE HARVIE CORPORATION, Ltd., 11, Queen Victoria-street, E.C. 4.—Various folders and cards explaining the properties and method of using Cemenfortis for the induration, waterproofing and hardening of concrete.

PHOTOCHEMICAL REACTIONS IN LIQUIDS AND GASES.—The Faraday Society will hold a general discussion at Oxford on October 1st and 2nd next, on "Photochemical Reactions in Liquids and Gases." The subject will be discussed under two main heads: (1) Einstein's law of photochemical equivalence, (2) the mechanism of photochemical reactions. Part I. will be opened by Professor A. J. Allmand (King's College), and Part II. by Professor M. Bodenstein (Berlin). In addition to the leading English workers on photochemical action, many distinguished investigators from the Continent and America have signified their intention of taking part in the proceedings. It is hoped to accommodate all who attend the meeting at Exeter College and Lincoln College. Non-members of the Faraday Society may attend the meeting, and those desirous of doing so are asked to communicate at once with the secretary of the Faraday Society at 90, Great Russell-street, London, W.C. 1, from whom full particulars may be obtained.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
Native	20/-
(1) Spanish	21/-
(1) N. African	21/-
N.E. COAST—	
Native	—
Foreign (c.i.f.)	21/6

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	4 7 6	—
No. 1 Foundry	4 7 6	—
No. 3 Foundry	4 5 0	—
N.E. COAST—		
Hematite Mixed Nos.	3 18 6	3 18 6
No. 1	3 19 0	3 19 0
Cleveland—		
No. 1	3 18 0	3 18 0
Silicious Iron	3 18 0	3 18 0
No. 3 G.M.B.	3 13 6	3 13 6
No. 4 Foundry	3 13 0	3 13 0
No. 4 Forge	3 12 0	3 12 0
Mottled	—	—
White	—	—
MIDLANDS—		
(3) Staffs.—		
All-mine (Cold Blast)	10 10 0	—
North Staffs. Forge	3 17 6	—
,, ,, Foundry	4 7 6	—
(3) Northampton—		
Foundry No. 3	3 7 6 to 3 9 0	
,, Forge	3 4 6 to 3 6 0	
(3) Derbyshire—		
No. 3 Foundry	3 12 6	—
Forge	3 8 0	—
(3) Lincolnshire—		
No. 3 Foundry	4 0 0	
No. 4 Forge	3 15 0	—
Basic	3 15 0	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 12 0 (a) / 4 14 6 (b) / 5 0 0 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	11 12 6	—
Best ,,	—	—
N.E. COAST—		
Common Bars	11 12 6	—
LANCS.—		
Crown Bars	12 0 0	—
Second Quality Bars	11 10 0	—
Hoops	15 0 0	14 15 0
S. YORKS.—		
Crown Bars	13 0 0	—
Best ,,	13 10 0	—
Hoops	14 10 0	—
MIDLANDS—		
Crown Bars	12 7 6	—
Marked Bars (Staffs.)	14 10 0	—
Nut and Bolt Bars	11 7 6	—
Gas Tube Strip	12 15 0 to 13 0 0	

STEEL.

	(6) Home. £ s. d	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	12 10 0	—
Ship Plates, ¾in. and up	8 12 6	—
Sections	8 2 6	—
Steel Sheets, under 3/16in. to ¼in.	10 0 0	—
Sheets (Gal. Cor. 24 B.G.)	—	17 10 0

STEEL (*continued*).

	Home. £ s. d.	Export £ s. d
N.E. COAST—		
Ship Plates	8 10 0	—
Angles	8 5 0	—
Boiler Plates	12 10 0	—
Joists	8 5 0	—
Heavy Rails	8 10 0	—
Fish-plates	12 15 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	9 0 0	—
Soft Billets	7 10 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 15 0†	—
Light ,,	9 0 0 to 9 5 0	
Billets	8 0 0 to 11 0 0†	
MANCHESTER—		
Bars (Round)	9 0 0 to 10 0 0	
,, (others)	8 15 0 to 9 0 0	
Hoops (Best)	15 5 0	15 0 0
,, (Soft Steel)	13 15 0	13 10 0
Plates	9 5 0	—
,, (Lancs. Boiler)	12 10 0	—
SHEFFIELD—		
Siemens Acid Billets	11 10 0	—
Bessemer Billets	13 0 0	—
Hard Basic	9 0 0 to 9 5 0	
Intermediate Basic	8 0 0 to 8 15 0	
Soft Basic	7 15 0	—
Hoops	12 0 0	—
Soft Wire Rods	9 10 0 to 11 0 0	
MIDLANDS—		
Small Rolled Bars	8 15 0	—
Billets and Sheet-bars	6 15 0 to 7 0 0	
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	16 10 0 to 16 15 0	
Angles	8 7 6 to 8 15 0	
Joists	8 7 6 to 8 15 0	
Tees	9 7 6 to 9 15 0	
Bridge and Tank Plates	9 0 0 to 9 5 0	
Boiler Plates	13 0 0	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	19/9 to 20/3
Block Tin (cash)	254 17 6
,, (three months)	265 0 0
Copper (cash)	80 10 0
,, (three months)	81 7 6
Spanish Lead (cash)	33 8 9
,, (three months)	32 18 9
Spelter (cash)	34 7 6
,, (three months)	33 13 6
MANCHESTER—	
Copper, Best Selected Ingots	63 15 0
,, Electrolytic	64 15 0
,, Strong Sheets	90 0 0
,, Tubes (Basis Price)	0 1 1
Brass Tubes (Basis price)	0 0 11½
,, Condenser	0 1 2
Lead, English	35 15 0
,, Foreign	34 10 0

FERRO ALLOYS.

(All prices now nominal.)

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/8 to 1/9 per lb.	
Ferro Tungsten	1/5 to 1/6 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£24 0 0	8/-
,, 6 p.c. to 8 p.c. ,,	£23 5 0	7/9
,, 8 p.c. to 10 p.c. ,,	£23 0 0	7/6
,, Specially Refined		
,, MAX. 2 p.c. carbon	£43 0 0	15/6
,, ,, 1 p.c. ,,	£52 0 0	17/-
,, ,, 0.70 p.c. carbon	£57 10 0	19/-
,, ,, carbon free	1/5 per lb.	
Metallic Chromium	4/- per lb.	
Ferro Manganese (per ton)	£15 for home, £15 for export	
,, Silicon, 45 p.c. to 50 p.c.	£12 15 0 scale 5/- per unit	
,, ,, 75 p.c.	£22 10 0 scale 6/- per unit	
,, Vanadium	16/- per lb	
,, Molybdenum	7/- per lb.	
,, Titanium (carbon free)	1/- per lb.	
Nickel (per ton)	£175	
Cobalt	10/3 per lb.	
Aluminium (per ton)	£130	

FUELS.

SCOTLAND.

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	14/9
,, ,, Ell	14/9
,, ,, Splint	15/9 to 18/9
,, ,, Trebles	14/9
,, ,, Doubles	14/-
,, ,, Singles	13/3
AYRSHIRE—	
(f.o.b. Ports)—Steam	14/9
,, ,, Splints	15/9
,, ,, Trebles	14/9
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	13/3 to 15/9
Screened Navigation	21/6
Trebles	15/-
Doubles	13/-
Singles	12/3
LOTHIANS—	
(f.o.b. Leith)—Best Steam	14/6
Secondary Steam	14/-
Trebles	14/3
Doubles	13/3
Singles	13/-

ENGLAND.

(8) N.W. COAST—	
Steams	26/-
Household	45/- to 58/4
Coke	28/-
NORTHUMBERLAND—	
Best Steams	16/6 to 17/-
Second Steams	16/3 to 16/6
Steam Smalls	10/6 to 11/9
Unscreened	15/6 to 16/6
Household	23/6 to 25/-
DURHAM—	
Best Gas	18/9 to 19/-
Second	16/6 to 17/-
Household	23/6 to 25/-
Foundry Coke	20/- to 22/6
SHEFFIELD—	Inland.
Best Hand-picked Branch	30/- to 33/- —
Barnsley Best Silkstone	26/- to 27/- —
Derbyshire Best Brights	23/- to 25/- —
,, ,, House	21/- to 23/- —
,, ,, Large Nuts	17/6 to 20/- —
,, ,, Small	12/- to 14/- —
Yorkshire Hards	17/6 to 21/- —
Derbyshire ,,	17/6 to 21/- —
Rough Slacks	10/- to 12/6 —
Nutty ,,	8/6 to 10/- —
Smalls	3/- to 5/6 —
Blast-furnace Coke (Inland)*	— —
,, ,, (Export)	f.o.b. 16/- to 16/6

(9) SOUTH WALES.

CARDIFF—	
Steam Coals:	
Best Smokeless Large	25/6 to 26/-
Second ,, ,,	24/6 to 25/-
Best Dry Large	24/6 to 25/-
Ordinary Dry Large	23/6 to 24/6
Best Black Vein Large	24/- to 24/6
Western Valley ,,	23/6 to 24/-
Best Eastern Valley Large	23/- to 24/-
Ordinary ,, ,,	22/6 to 23/-
Best Steam Smalls	14/- to 15/-
Ordinary ,,	13/- to 14/-
Washed Nuts	20/- to 27/6
No. 3 Rhondda Large	26/6 to 27/-
,, ,, Smalls	16/6 to 17/-
No. 2 ,, Large	21/- to 22/-
,, ,, Through	18/- to 20/-
,, ,, Smalls	11/- to 12/-
Foundry Coke (export)	40/- to 45/-
Furnace Coke (export)	25/- to 30/-
Patent Fuel	22/- to 26/-
Pitwood (ex ship)	26/- to 26/6
SWANSEA—	
Anthracite Coals:	
Best Big Vein Large	41/6 to 43/-
Seconds	35/- to 38/-
Red Vein	28/- to 31/-
Machine-made Cobbles	52/6 to 55/-
Nuts	50/- to 54/-
Beans	35/- to 37/6
Peas	21/- to 23/-
Breaker Duff	8/- to 8/3
Rubbly Culm	12/6 to 12/9
Steam Coals:	
Large	21/- to 24/-
Seconds	20/- to 21/-
Smalls	10/- to 13/-
Cargo Through	16/- to 19/-

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated. coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. * For blast-furnaces only, 16/6, with fluctuations according to analysis; open market, 16/6 to 18/- at ovens. † Latest quotations available. (a) Delivered Glasgow. (b Delivered Sheffield. (c) Delivered Birmingham.

French Engineering Notes.

(From our Correspondent in Paris.)

The Trade Crisis.

Now that the trade depression has become fairly general in all producing countries, makers are considering what means should be taken to arrest the decline, and for that reason fresh interest is being shown in the negotiations for a restriction of the iron and steel output. So far as the French firms are concerned, such restriction would be effected willingly if only they could see that an arrangement with foreign producers would assure them an acceptable participation in the business available. A little while ago it was affirmed that negotiations with German steel makers were proceeding satisfactorily, and that an agreement between the two countries would certainly be followed by the admission of British and Belgian makers into the proposed Steel Union. As a matter of fact, the French cannot come to a complete understanding amongst themselves, and the Germans have been holding out for terms which are wholly unacceptable under present conditions, so that a final settlement seems as far off as ever. How small is the chance of doing anything just now is seen in the attitude of some members towards the syndicate for the maintenance of iron and steel prices. The period for which the syndicate was formed expires next month, and while it was hoped that it would be renewed on the basis of a restriction of output, some makers are reported to be in favour of withdrawing so that they may be free to compete for business. It is generally believed that the syndicate will be renewed simply on the basis of a minimum scale of prices.

Coal Slump.

The restricted consumption of industrial coal is seriously affecting the colliery industry, which has been steadily increasing the output until now stocks are accumulating everywhere. In Belgium the stocks are stated to be 3,000,000 tons, while in the Ruhr they are reported to reach a total of 10,000,000 tons. Many of the German collieries are said to be reducing output, and the French coalowners would gladly seize a pretext to do the same. It is probably for that reason that the miners in the Nord hesitate to reject the coalowners' offer to cut down the special bonus for high living cost by one-half instead of suppressing it altogether, as they had proposed. The colliery industry is certainly passing through a difficult period all over North-Western Europe, and the coal imports into France may undergo a still further decline, except, perhaps, of steam coals.

Fiscal Tariffs.

The question of import duties has again been brought to the fore this week by the issue of a circular from the Ministry of Commerce to all the industrial and commercial bodies, requesting them to send in their observations without loss of time upon the classification of goods in the forthcoming Tariff Bill. This move would suggest that the Bill is undergoing further modifications, for it was stated nearly a year ago that the Bill was completed, and apparently the change that has taken place since then in the economic situation has shown the wisdom of not being too hasty with the introduction of a measure which avowedly aimed at a closer industrial protection. The idea was to fix the duties on a gold basis and to classify the goods in such a way that each group would comprise goods of approximately the same value, so that the application of the duties would be practically equivalent to *ad valorem*. What gives special interest to the circular are the observations of the Minister, who states that, while it is necessary to protect industries, it would be fatal to impose exaggerated tariffs which would have the effect of ruining industries by provoking retaliation from other countries, and thereby suppressing the export trade Moreover, tariffs are needed as a means of negotiating treaties of commerce. Nevertheless, if industries are protected by import duties the burden must not be allowed to fall upon the consumer, for which reason the Minister insists that manufacturers must adopt new methods of production, whereby they will be able to bring down costs. As a matter of fact, this question of cheaper methods of production is of the first importance, since business is becoming more and more difficult with the increasing charges being imposed on industry.

Makhonine Fuel.

The Société des Ingénieurs Civils has not yet succeeded in coming to an agreement with M. Makhonine for the carrying out of a scientific and perfectly impartial trial of his apparatus for the production of a motor fuel direct from crude oils. The Minister of War offered to place at the disposal of the Committee the apparatus used in the Vincennes trials, together with all documents relating to the tests, on the sole condition that the offer must be approved of by M. Makhonine. After prolonged negotiations with the Russian engineer, who claimed that he must first have the right to consult the official documents, and reply to any points therein, the Committee of the Société des Ingénieurs Civils has now informed him that unless he accepts the test within ten days the proposal to carry out the official trial will be definitely abandoned.

Paris Water Supply.

Contrary to the usual experience, the spell of exceptionally hot weather has not so far resulted in a serious drain upon the Paris water supply, although in one day the consumption amounted to 630,000 cubic metres. Nevertheless, a continuance of the heat may very well cause embarrassment, and work is being pushed forward actively with the new filtering beds at Ivry. If the supply is sufficient for the moment, the existing mains are quite unable to cope with the requirements, and at certain elevations the water pressure is very low. The various costly projects which are being investigated for bringing additional supplies of water to Paris would therefore appear to be of little avail unless the mains are re-laid.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

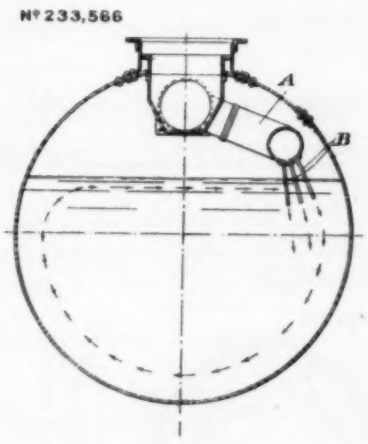
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

CONDENSERS AND FEED-WATER HEATERS.

233,566. July 21st, 1924.—HEAT ACCUMULATORS, Galloways Ltd., Knott Mill Ironworks, Manchester, and H. Pilling, Glenderwyn, Manchester-road, Choriton-cum-Hardy, Lancs.

This invention aims at the thorough circulation of the water in "accumulators" used for conserving the heat from non-condensing engines. The exhaust steam is distributed inside the accumulator by branch pipes A, which are furnished with nozzles B reaching below the water surface and so directed that they

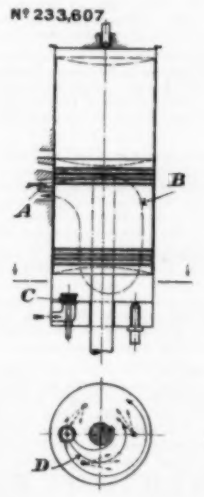


tend to cause a circulation of the water round the shell. Small holes are drilled in the branch pipes above the water line to prevent a vacuum being formed in the exhaust pipe in the event of the supply of steam being cut off, which would result in water being sucked back into the pipe, while other small holes, drilled transversely in the nozzles just below the water line, produce a flow along the surface, which carries the scum towards the blow-off connection.—*May 14th*, 1925.

INTERNAL COMBUSTION ENGINES.

233,607. November 15th, 1924.—DOUBLE-ACTING TWO-STROKE ENGINES, Mfbk. Augsburg-Nurnberg A.G., 7, Stadtbachstrasse, Augsburg, Germany.

This is another invention connected with the problem of ensuring the thorough admixture of the mechanically injected fuel oil spray and the air necessary for its combustion, particularly on the bottom side of the piston of a double-acting engine. The main scavenging air enters the cylinder through the port A and

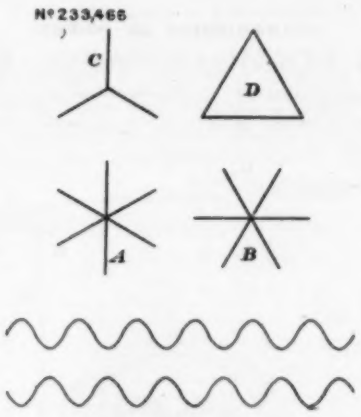


follows the course indicated by the arrow B. In the bottom cylinder cover an additional scavenge air valve C is fitted with a baffling device so that the entering air takes a circular path around the piston-rod as outlined by the curve D. The air is admitted to the cylinder through the valve C after the main scavenging ports have been closed by the piston, and the turbulence so caused improves combustion conditions.—*May 14th*, 1925.

TRANSFORMERS AND CONVERTERS.

233,466. February 23rd, 1925.—IMPROVEMENTS IN AND RELATING TO ROTARY CONVERTERS, Adolph Harry Railing and Robert Gordon Jakeman, both of Magnet House, Kingsway, W.C. 2.

The object of this invention is to eliminate pulsations in the direct-current pressure of rotary converters. The rotary converters are run in pairs and they are connected to two sets of transformer secondaries in such a way that the ripples are completely cancelled. In the diagram the transformer secondaries A and B are connected in accordance with the diametrical star method and the primaries C and D star and delta for six ring converters. With this arrangement the pulsations in the direct current occur 30 deg. later in one rotary than they do in the other, as shown in the lower diagram, and as the pulsations have a frequency six times the fundamental frequency, maximum and minimum pulsations occur in any part of one machine 30 deg. apart. The pulsations in one machine are thus made to cancel out those in the other and are entirely eliminated from the total direct-current pressure of the two rotary con-

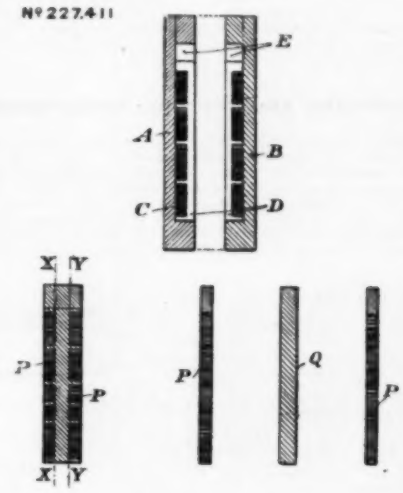


verters in series. Another advantage is attained, if an odd number of armature slots be provided for the portion of the armature windings covering 60 electrical degrees, because the high-frequency pulsations in the direct-current pressure caused by the armature slots passing the pole faces then occur half a tooth later in one converter, as compared with the other converter, so that they are entirely eliminated from the total direct-current pressure of two machines in series.—*May 14th*, 1925.

BATTERIES AND ACCUMULATORS.

227,411. July 1st, 1924.—IMPROVEMENTS IN OR RELATING TO ACCUMULATOR GRID PLATES, Hugo Keller, of 42, Marksstrasse, Cannstatt-on-Neckar, Würtemberg.

This invention relates to an improved method of casting accumulator grid plates with a fine mesh. The two parts of the mould are shown at A and B, whilst C and D are the spaces for

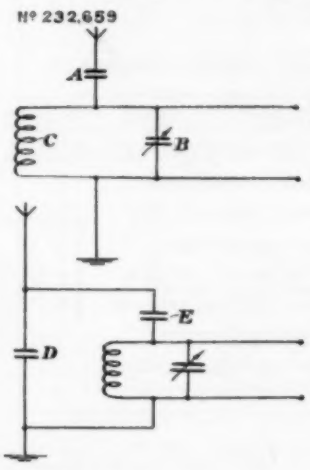


the metal of which the grid is made. The metal is introduced at E, and the cast metal which occupies the space E forms the lug or tag of the accumulator grid plate. After the grid has been cast it is cut along the planes X X and Y Y so as to form two plates P P, and a core Q which may be melted for further use.—*May 14th*, 1925.

TELEGRAPHS AND TELEPHONES.

232,659. November 1st, 1923.—IMPROVEMENTS IN AND RELATING TO WIRELESS AERIAL CIRCUITS, John Scott-Taggart, of 34, Norfolk-street, Strand.

Many wireless experimenters are probably familiar with the



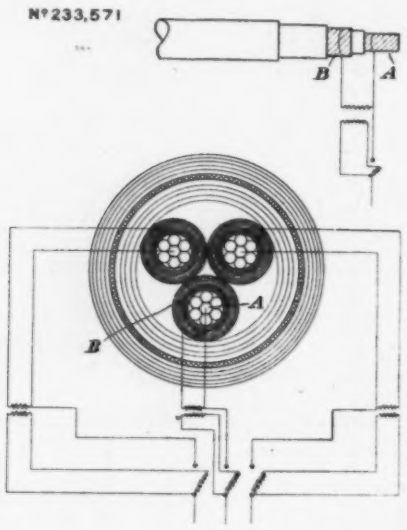
scheme described in this specification. To make tuning substantially independent of the aerial capacity, a condenser of small capacity, say, .0001 microfarads, is connected in series with the

aerial as shown at A, B being the tuning condenser connected in parallel with the tuning inductance. It is well known that this arrangement enables a receiver to be worked on aerials of different capacities with practically no readjustment of the variable condenser shunted across the inductance C, because the aerial capacity is reduced to a low value. A development of the idea is shown in the lower diagram, where fixed condensers are connected at the points D E.—*May 1st*, 1925.

TRANSMISSION OF POWER.

233,571. July 31st, 1924.—IMPROVEMENTS IN OR RELATING TO ELECTRICAL CONDUCTORS, Dr. Heinrick Glaser, of Malmedyerstrasse No. 13, Eupen, Belgium.

This specification describes a safety arrangement for electric conductors. When, owing to the insulation being damaged, a connection is established between the main conductor A and

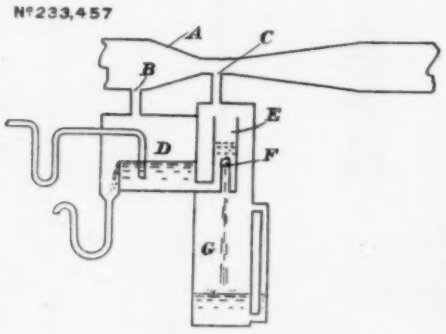


a metallic sheath B a potential difference that normally exists between the two is destroyed, and by means of an arrangement of transformers, indicated in the diagram, trip gear is brought into action and the damaged part of the cable is disconnected.—*May 14th*, 1925.

MEASURING AND TESTING INSTRUMENTS.

233,457. February 19th, 1924.—FLOW METERS, W. H. Lake, Cranbrook, Harpfield, Stoke-on-Trent.

This meter integrates the flow through a restricted orifice by collecting another fluid in proportion to the rate of flow of the fluid to be measured. A gas, for instance, flows through the Venturi tube A and its rate of flow varies approximately as the square root of the difference of pressure between the connections B and C. The tank D is supplied with water, as indicated, in

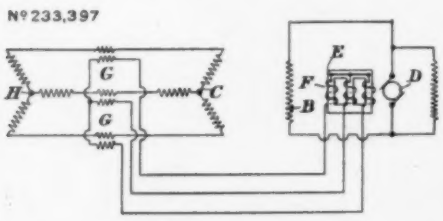


such a manner that a constant water level is maintained. The communicating chamber E connected with the branch C is provided with an outlet orifice F, the drainage from which is collected in G. The water level in E will be dependent on the difference in pressure between B and C and the flow through the outlet F will vary as the square root of the head above it. The flow of the gas and that of the water consequently obey the same law and the rate of accumulation of water in G is a measure of the flow through the Venturi tube.—*May 14th*, 1925.

SHIPS AND BOATS.

233,397. February 2nd, 1924.—IMPROVEMENTS IN ELECTRICAL MARINE PROPULSION, Adolph Harry Railing and Max Ludwig Kahn, both of Magnet House, Kingsway, W.C. 2.

An improved method is described in this specification of controlling the excitation of alternating-current generators

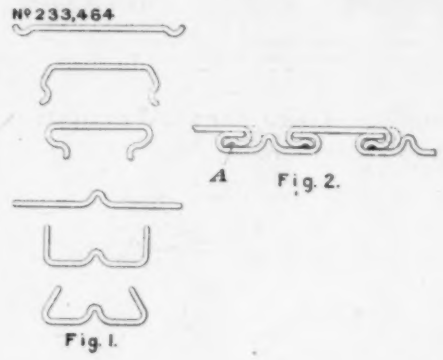


used for ship propulsion. D is the dynamo for energising the field B of the alternator C. The field magnets of the exciter have a magnetic shunt E provided with windings, fed with current from current transformers G. H is the motor which drives the ship. The principle on which the scheme works is fairly well known.—*May 4th*, 1925.

MISCELLANEOUS.

233,464. February 22nd, 1924.—METALLIC FLEXIBLE TUBING, G. Rudolph, Interlock Metal Hose Company, River Park-road, Wood Green, London, N. 22.

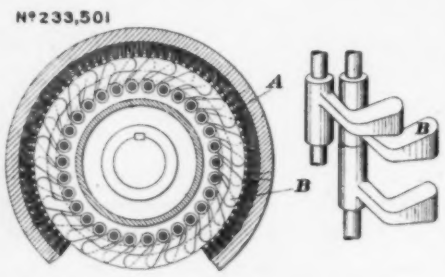
The idea of this invention is to make metallic flexible tubing of symmetrically formed strips, so that its manufacture may be expedited, as compared with that made of asymmetric strips.



The several stages in the formation of the two strips are shown in Fig. 1, while Fig. 2 shows the two strips rolled together with a packing thread at A to make a tight joint. The dotted lines indicate the degree of flexibility. The contacting faces of the strips are serrated to reduce axial torsion when the tube is subjected to high pressures.—*May 14th*, 1925.

233,501. April 10th, 1924.—FIBRE BEATING MACHINES, H. Jackson, Ltd., Oaken Clough Paper Mills, Garstang, Lancs., and H. Jackson.

This machine is for hydrating fibres for papermaking, by means of a gentle hammering or tapping action, while the fibre is



thoroughly wet. The main casing is lined with a series of bronze bars A, which are spaced apart by means of wooden distance pieces, while the rotor is furnished with a series of cranked beaters B, also of bronze, of which a detail perspective view is given. The pulp is circulated axially through the machine by an external pump.—*May 14th*, 1925.

CONTRACTS.

JOSEPH KAYE AND SONS, Ltd., of Leeds, inform us that they have received a large contract from the Admiralty for their improved force-feed type of serrated steel seamless oil feeders.

UNITED WATER SOFTENERS, Ltd., of Kingsway, London, have recently received from twelve separate customers in this country and abroad orders for water softening and purification plant for dealing with a total of over a million gallons per day. The plants vary in size from 12,000 to 480,000 gallons in the twenty-four hours.

GOODWIN, BARSBY AND CO., Ltd., of Leicester, have received from the Kilkenny County Council a repeat order for an Acme stonebreaker; from the Waterford, Wicklow and Cork County Council an order for Acme machines; from the Leicester Corporation an order for two additional concrete mixers; and from the Manchester and Hull Corporations for concrete mixers.

THE SPERRY GYROSCOPE COMPANY, Ltd., of 15, Victoria-street, London, S.W. 1, informs us that the vessels Alaunia and Carinthia, of the Cunard Steamship Company, Ltd., which will shortly run their trials, will both be equipped with a Sperry gyro master compass, repeaters and course recorder. In each case an additional repeater will be installed in the wireless room to operate in conjunction with the wireless direction finder.

WE are informed that four high-power mercury arc rectifiers which are made by Brown, Boveri and Co. and are marketed in this country by Power-Rectifiers, Ltd., each for an output of 1500 kilowatts at 1500 volts direct current, have recently been supplied to the Illinois Central Railroad Company, of Chicago. The company has also supplied fifteen 1000-kilowatt sets, each consisting of two rectifiers, for the Dutch Railway electrification between Rotterdam and Amsterdam; and two direct current 1000-kilowatt sets to the Ford Motor Company, of Detroit.

INSTITUTION OF ELECTRICAL ENGINEERS.—The Council of the Institution of Electrical Engineers has awarded students' premiums, value £10 each, to the following:—Mr. P. G. Ashley, B.Sc. (Hebburn-on-Tyne), Mr. D. I. Dawbarn (Monkseaton), Mr. E. Gallizia (Birmingham), Mr. J. H. Reyner (London), Mr. W. R. T. Skinner, B.Sc. (Leeds), and Mr. G. E. Barrett, B.Sc. (Tech.) (Leeds), Mr. A. Tustin, M.Sc. (Manchester).

THE INSTITUTION OF HEATING AND VENTILATING ENGINEERS.—The summer meetings of the Institution of Heating and Ventilating Engineers will be held at Birmingham on the 22nd, 23rd, and 24th inst. The following programme has been arranged:—On Monday, June 22nd, at 5.30 p.m., there will be a Council meeting at the Queen's Hotel. On the Tuesday, at 9.30 a.m., the general meeting will be held at the Queen's Hotel. The ladies of the party are invited to visit during the morning the Birmingham Art Gallery. Cadbury Bros., Ltd., have invited members and their ladies to visit their works at Bournville in the afternoon. In the evening there will be a banquet at the Queen's Hotel. On the Wednesday, starting at 9.30 a.m., a motor drive will be taken through Shakespeare's country.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY AND SATURDAY, JUNE 20TH.

NEWCOMEN SOCIETY.—Summer meeting at Gloucester.

SATURDAY, JUNE 20TH.

THE INSTITUTE OF BRITISH FOUNDRYMEN: LANCASHIRE BRANCH.—Visit to the works of Ley's Malleable Castings Company, Limited, Derby. 2.30 p.m. The party will leave Manchester (Central) at 12.20 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS: NORTH MIDLAND CENTRE.—Joint visit with the Institution of Mechanical Engineers to the hydro-electric power station at Linton Lock, near York. Conveyances will leave the railway station at York at 1.45 p.m.

MONDAY TO WEDNESDAY, JUNE 22ND TO 24TH.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS.—Summer meetings at Birmingham. For programme see below.

WEDNESDAY, JUNE 24TH.

SOCIETY OF GLASS TECHNOLOGY.—University College, Gower-street, London, W.C. 1. Papers: (A) "An Attempt to Improve the Quality of Glasses for Lamp Working," by Professor W. E. S. Turner; and (B) "A Study of the Influence of Boric Oxide on the Properties of a Glass Intended for Chemical Resistances Purposes," by Professor W. E. S. Turner and Mr. F. Winks: Part I., "The General Properties of Glasses;" Part II., "The Influence of Boric Oxide on the Physical Properties of Glasses;" and Part III., "The Effect of Boric Oxide on the Durability." 2.30 p.m.

MONDAY, JUNE 29TH.

MANCHESTER GEOLOGICAL AND MINING SOCIETY.—Visit to the Preesall Salt Mines near Fleetwood. Train leaves Manchester (Victoria Station) 8.45 a.m.

THURSDAY, JULY 2ND.

INSTITUTION OF ELECTRICAL ENGINEERS.—At the Natural History Museum, Cromwell-road, London, S.W. Conversazione. 8.30 p.m.

SATURDAY, JULY 11TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Town Hall, Westcoe-road, South Shields. North-Eastern District meeting. 11 a.m.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

THE Marconi wireless station at Clifden in Ireland is to be dismantled, and has been sold to Thos. W. Ward, Ltd., of Sheffield, for that purpose.

MR. G. F. HORSLEY, an original member of the Institution of Chemical Engineers, has been appointed to the post of Director of Research for the Nitrate Producers' Association of Valparaiso, Chile.

ROTAX (MOTOR ACCESSORIES), Ltd., Rotax Works, Willesden Junction, London, N.W. 10, informs us that it has appointed Messrs. Nibbs and Scott, 24, Great Southsea-street, Southsea, as its official service agents for Portsmouth and district.

THE J. G. BRILL COMPANY asks us to announce that it has changed its address from 150, Southampton-row, London, W.C. 1, to Aldwych House, Aldwych, London, W.C. 2. Telephone, Holborn 6344; and telegrams, "Axles, London."

WE are asked to state that Mr. M. G. Wallace, B.Sc., A.M.I.E.E., has resigned his appointment as combustion engineer of the Stirling Boiler Company, to take up the London representation of Howden-Ljungstrom Preheaters (Land), Ltd., of Govan. Mr. Wallace's address will be Caxton House, Westminster.

LAUNCHES AND TRIAL TRIPS.

SANDLAND, single-deck screw steamer with hopper for carrying sand and gravel; built by Swan, Hunter and Wigham Richardson, Ltd., Wallsend-on-Tyne, to the order of Messrs. Terry and Robertson, of Toronto; dimensions, 205ft. by 42ft. 6in. by 18ft. 6in. moulded at side of main deck; to carry about 1750 tons. Engines, three-crank inverted marine type; constructed by McColl and Pollock, Ltd., of Sunderland; launch, June 6th.

TJISAROEA, turbine passenger and cargo steamer; built by the Netherland Shipbuilding Company (Nederlandsche Scheepsbouw-Maatschappij), of Amsterdam, to the order of the Java-China-Japan Line; dimensions, 420ft., 55ft. by 37ft. Engine, Parsons turbine of 3000 brake horse-power; launch, June 6th.

BRITISH PETROL, motor tanker; built by Swan, Hunter and Wigham Richardson, Ltd., at their Neptune Works, Newcastle-on-Tyne, to the order of the British Tanker Company, Ltd., of London; dimensions, 454ft. long by 57ft. beam; to carry 10,100 tons total deadweight on a draught of 26ft. 8in. Engines, "Neptune" two-cycle, single-acting, port-scavenging internal combustion type, eight cylinders, 24in. diameter by 50in. stroke, designed to develop 3200 brake horse-power; constructed by the builders; launch, June 8th.

CORNER BROOK, single-screw steamer; built by Sir W. G. Armstrong, Whitworth and Co., Ltd., at the Walker Shipyard, to the order of the Newfoundland Export and Shipping Company; dimensions, 439ft. long overall; breadth moulded, 56ft.; depth moulded to upper deck, 39ft.; to carry paper in bulk to a total deadweight of 8600 tons. Engines, triple-expansion, 28in., 46in. and 77in. by 51in. stroke, pressure 180 lb.; constructed by the builders at their Elswick Marine Engine Works; launch, June 8th.

JEVINGTON COURT, steamship; built by Workman, Clark and Co., Ltd., to the order of Haldin and Co., Ltd. Engines, single-screw, vertical inverted, direct-acting, surface condensing, triple-expansion type; constructed by Workman, Clark and Co., Ltd. launch, June 9th.